2: Mariner F-5 (1806-1810) 1818
OU9 Tonga OU9

Hapai islands, when he received his long wished-for present; but he made no use of it till about three weeks afterwards, when he had returned to Vavaoo. In the mean time Maccapapa, Lolo hea Bibigi, and three others, all chiefs and warriors, secretly left Vavaoo, and sailed for Tonga, to join Taky', chief of the fortress of Bea (who formerly burnt Finow's fortress of Nioocalofa in so treacherous a manner). They took this step, being apprehensive that the king might hereafter wreak his vengeance on them for fighting against him: the sequel will show how far their apprehensions were well grounded.

Whilst Finow was yet at the Hapai islands, Mr. Mariner accompanied the prince to the island of Tofooa, to procure iron-wood, which is found there in great abundance. The prince first obtained leave from Tooitonga, (the divine chief,) for this island is his property, and therefore considered sacred; besides, it is supposed to be the residence of the sea gods, and on this account the people firmly believe that no sharks will hurt a man who is swimming near upon its coast, but, on the contrary, swim round him, and even pass so close as to touch him, without shewing the least hungry disposition. Mr. Mariner, however, never had an

2: Mariner F-5 (1806-1810) 1818
OU9 Tonga OU9

opportunity of witnessing the miraculous abstinence of this sort of fish.

On the island of Tofooa there is a small volcano, situated near the northern extremity, from which smoke almost constantly issues, and pumice-stones are very frequently thrown out. An eruption of flame takes place, sometimes twice or thrice a week, and at other times scarcely once in two months, and generally lasts from one to two or three days. The way to the top is extremely difficult; but Mr. Mariner, taking one of the natives of the island for a guide, resolved to ascend it. They began the ascent early in the morning, and, although their progress was much impeded by the quantity of loose pumice-stone, and often rendered very dangerous, they reached the top in about four hours. There was at this time no eruption of flame, which had ceased a few hours before, after having lasted three days; smoke there was, however, in abundance, but which did not much annoy them, as they were on the windward side: sundry explosions were also heard from within, like the noise of water being thrown upon burning pitch. The crater was about thirty feet diameter. Whilst they were here, Mr. Mariner took care not to let his companion approach too near, lest he might

8: Collocott & Havea M,I-5 (no date) 1922
OU9 Tonga OU9

14. Taka i fonua mahu: Going about or living in a fruitful land. 539 181

This indicates the general prosperity and comfort of a people when crops are good and none suffers want.

15. Tatau pe tua mo palai: The *tua* just like the *palai*. 539 244 554

The *tua* and the *palai* are two sorts of yam, of which the *tua* is much the finer. That which is excellent leaves its proper excellence, becoming the mere equal of things of no account; the chief descending to be no better than the commoner.

16. Toukai mo hono lohu: A crop of fruit and its *lohu*. 539 245

The crop referred to is the breadfruit. The *lohu* is the forked stick used for picking the breadfruit. When the breadfruit is ripe a man may find that the stick that he has used in a previous season is rotten, and so he has to get another. Probably these sticks are very seldom kept from season to season. The idea is that with the crop one must get a stick for that crop. So of the needs and opportunities of a particular period the men will be found to meet them. [829]

17. Ufilei fie ufi: An *ufilei* that wants to be a yam (*ufi*). 539 244 554 829

Ufi is the general name for all kinds of yam. The *ufi-lei* is a small sweet yam. This indicates one of these small sweet yams that wants to be some other sort of yam. Applied to people who not satisfied with being what they are try to be like someone else.

18. Utu ta lau: Harvesting, cutting off leaves. 539 244

This is an expression from the yam harvest and indicates primarily a man who digs his yams before they are quite ready, when the tops will have died off. He strikes or cuts off the tops as he digs his crop. The application of such an expression in Tongan is similar to what it would be in English.

PLANTS AND TREES

19. Akau tuu hala: Tree standing (in a) road, and so liable to be splashed with mud, struck with knives, or otherwise injured. 539 824

This proverb or this explanation is probably modern, as before the introduction of wheeled traffic and of steel implements it would seem that the road-side tree was not exposed to especial injury. However, even under ancient conditions the road-side tree would offer itself first to those in search of timber. [313]

20. Faifaimalie naa ke pakii ha lau telie: Go carefully lest thou pluck (break off) a *telie* (*Terminalia catappa*, or *T. litoralis*) leaf. 539 784 829

This phrase is a warning to proceed with care lest a tabu be broken. We do not know its origin.

14: Thomson G-3 (1886-1891) 1894
OU9 Tonga OU9

175 177 609 643 782 condition that he bared his shoulders; for the Tongans, then as now, did not expect foreigners to conform to their manners, and were lenient to any breach of their laws committed by a stranger in ignorance. On June 25 he set sail, after a stay of seven weeks, and not many months later met his tragic end in Hawaii from an over-confidence in the natives, which his experience of the Tongans (whom he misnamed the "Friendly Islanders") may have helped to engender.

175 178 721 It seems strange that a people who, to both Tasman and Cook, appeared unaccustomed to the use of arms, should, twenty-two years after the visit of the latter, be found practising all the barbarities of savage warfare. What internal ferment, one asks, can have produced so abrupt a change? Native traditionary history supplies the answer. Intercourse with Fiji was warping the Tongan character.

175 177 178 At the time of Cook's visit increasing and regular intercourse with Fiji was rapidly changing the Tongans for the worse. Ethnologically, between Fiji and Tonga [144] there is a great gulf fixed. The former belong to the great family of the Melanesians; the latter to the pure stock of the light-skinned race, which, for want of a [171] better name, are called the Malayo-Polynesians. The Fijians knew no higher form of society than that of the family or clan, shut up within its own intrenchments, at perpetual war with its neighbours; no nobler occupation than the devising of treachery against their enemies. But generations of peace had dulled the warlike instincts of the Tongans, and allowed their institutions to take a firm root. Timber for sea-going canoes was scarce in Tonga,

[313] [503]

[TEXT CONTINUED ON PAGE 320]

14: Thomson G-3 (1886-1891) 1894
OU9 Tonga OU9

and it was not until the eighteenth century that any but the principal chiefs could fit out expeditions for distant voyages. A little before 1750 several canoes had run down the wind to Lakemba, and their crews, after joining one or other of the local chiefs in war, and gaining him the victory by their superior daring, had taken their share of the spoil, exchanged their small canoes for larger craft, built of *vesi* from Kambara, and returned to their own country laden with exotic plunder, and boasting of their foreign experiences. Thenceforth an expedition to Fiji became the keystone of a Tongan chief's education, just as in Europe at the same period the "grand tour" was considered essential to the training of an English gentleman; and as our travellers brought back outlandish habits and strange wares, which were admired because they were foreign, so Cook found that the Tongans spoke of their neighbours as their superiors in war and in the useful arts. The cold-blooded treachery that will betray a brother to gratify the thirst for blood; the brutal ferocity that spares neither sex nor age; the depraved lust that is gratified in outrage on the dead; the foul appetite of revenge that will eat the body of a slain enemy,—all these seemed to the young Tongan the badges of a manliness worthy of imitation. He regarded the comparative refinement of his own people as effeminacy, and vied with his fellows in imitating the accomplishments of his more travelled countrymen. It would surprise the Tongan of to-day to hear that his fathers looked up to the Fijians as his superiors. A contempt born of familiarity has taught him to estimate the characteristics of his neighbours at something less than their proper

22: West M-3 (1846-1855) 1865 OU9 Tonga OU9

by the pressure of newly felt, and increasing necessities, arising from an extended intercourse with foreigners. But in the mean time these native prejudices must stand in the way of any scheme, of commercial enterprise, involving the employment of many hands.

In concluding our brief enumeration of the principal natural products of Tonga, it may be sufficient to say, that all the best islands contain trees which yield good timber for building purposes; but, both in variety and quantity, the supply is limited. The natives take no pains whatever to increase the stock of timber-yielding trees, in those localities that are adapted to their habits. There are, it is true, certain stringent regulations respecting the felling of timber; but there is at the same time an unnecessary and reckless waste of what nature herself affords. The best and largest trees are used in the construction of canoes. *Bobaos*, the smallest class of paddling canoes, are always cut out of single trees. *Tafaagas*, the beautiful and swift canoes that are employed in fishing for the bonito and albicore, and also the *hamatefuas*, or sailing canoes having only a single hull and large outrigger, are all built of planking, in the same style as the large *kalias*. These two classes of canoes, being required in considerable numbers, involve a great waste of valuable wood, inasmuch as only two, or, at most, three planks can be obtained, from a single tree, by the native method of cutting.

The *tamanu*; (*Calophyllum Burmanni*;) the *milo*; (*Thespesia populnea*;) the *futu*; (*Barringtonia speciosa*;) the *mohemohe*; the *fetau*; and the *tavahi*, are the trees from which good and durable

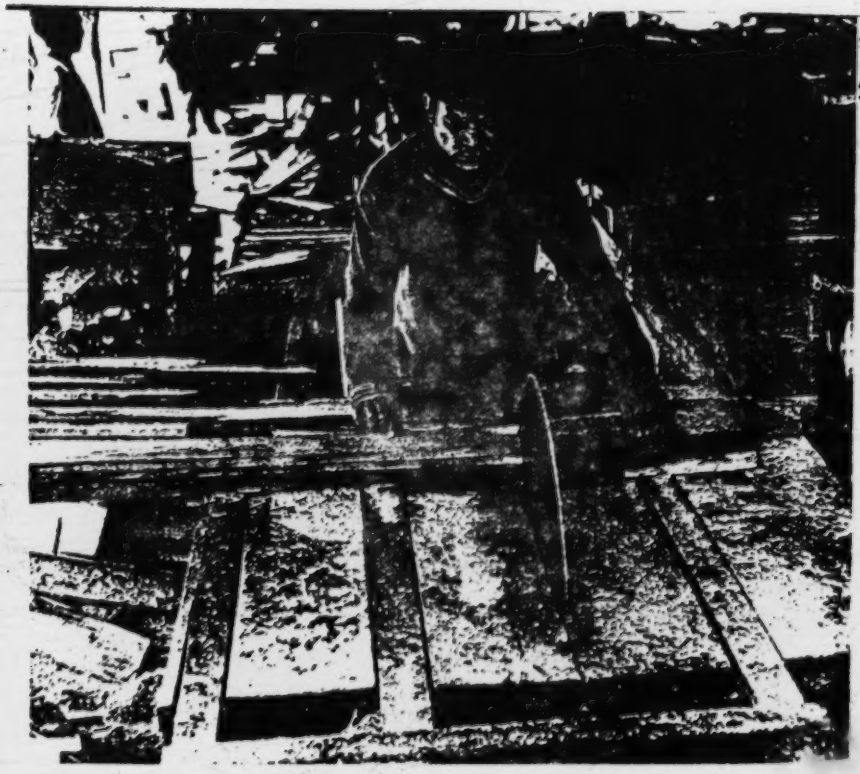
22: West M-3 (1846-1855) 1865 OU9 Tonga OU9

timber is obtained. The *toa*, or iron-wood tree, (*Casuarina equisetifolia*,) is somewhat abundant, but it is not much used by the natives, because of its excessive hardness and heaviness. Clubs and spears were made from it in former times. The large posts required for buildings are obtained from the *koka*, whose timber is very durable in the ground. It likewise affords the best firewood; and a dark liquid which exudes from its trunk, when the bark has been scraped off, is employed in stamping patterns upon the native cloth.

Some of the most stately and magnificent trees are only fit for firewood, and some not even for that. Among these may be reckoned the *orava*, a species of banyan; the *buko*, (belonging to the natural order of *Bombaceæ*,) and the *gatae*, (*Erythrina corallodendron*.) This latter tree is very commonly planted to distinguish the boundaries of land belonging to different proprietors.

Having considered, so far, the natural productions of the islands, as a whole, we shall now resume our personal narrative, by taking the reader to Vavau, where the first years of our residence were spent.

39: Gerstle & Raitt C,Q-4,5 (1952-1972) 1974 0U9 Tonga 0U9



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'Eua, which has the majority of forestry in Tonga, today supplies most of the Kingdom's timber. However, the five sawmills (1 large government one, 4 smaller, private ones) on the island are rapidly depleting 'Eua's supply of forest resources. (Photo: Angaha, 'Eua.)

Ko e fahi'anga papa eni 'i Angaha, 'Eua. Ko 'Eua foki 'oku lahi taha ai e vao ta fa'unga pea mo e fahi papa, ka kuo vave 'osi pe e papa ai. 'Oku nima e fahi'anga papa 'i 'Eua (1 'a e pule'anga, pea mo e 4 si'isi'i ange 'oku fakalele makehe).

161 increased by 36.2%, the increase was not uniform throughout
162 the islands. On the contrary, there was an absolute decrease in population on nine islands, and only two islands of more than one square mile in area had an increase in population of more than 20% over the figure for 1956. These are the islands of Tongatapu and 'Eua.

131 'Eua is a large island a few miles to the south-east
133 of Tongatapu. Because of intervening reefs, it can be
[505] reached only by a roundabout passage after a very rough
[313] sea-voyage of about five hours. The island rises in a series of rocky terraces to about 1,000 feet above sea level, with steep valleys that are the major source of timber in Tonga, leaving relatively little land suitable for cultivation. For these reasons, the island is not very attractive
161 for settlement. At the time of the census of 1939, the
162 population of 'Eua was only 480. After a volcanic eruption
166 on the northernmost island of Niuafo'ou in 1946, many of
[731] the people of that island were settled on 'Eua; at the census of 1956, more than 40% of the population of 'Eua over the age of nine had been born on Niuafo'ou. Besides this Niuafo'ou influx, the increase in the population of 'Eua is accounted for largely by migration from other islands,
161 especially by men seeking land. Even so, with an intercensal
162 population increase of 76.2%, the density of population on 'Eua in 1966 was only 100 per square mile, almost the lowest
[133] of any island in Tonga. Moreover, while there is still some

54: Cook G,T-5 (1777) 1967 OU9 Tonga OU9

tops of the Mounts round the houses, there were a few rude Images of the human figure, of different ages. We were told they were there as monuments to the Memory of the dead and not the representation of any Deity.[1] Such monuments they seldom raise for these seemed to be very old. In one of the house[s] was the Carved head of an Otaheite Canoe which had been driven a shore on their coast and deposited here. After dinner, or rather after we had refreshed our selves on what we carried with us, some of us took a Walk into the Country making a pretty large circuit attended by one of the Kings Ministers,[2] our train was not great as he would not suffer the rabble to follow us, he also obliged all those whom we met to sit down till we pass'd a respect due only to their Kings. We found by far the greatest part of the Country cultivated and planted with one kind of production or a nother and the most of these plantations were fenced round. Some old Plantations lay uncultivated or in fallow, and there were places that had never been touched but lay in a state of Nature but even these places were usefull in affording them timber &c[a] with which they were generally covered. We met with several large uninhabited house[s] which we were told belonged to the King or the Lord of the Manor;[3] there were many publick and well beaten roads and as many foot paths leading to every part of the island. The roads were good and the Country level consequently traveling was easy. On the most elevated parts, we met with coral rock close to the surface, perforated and cut into all those inequalities we see them in the wash of the sea, yet these very rocks with hardly any soil upon them were covered with a luxuriant vegetation. We were conducted to several little pools and some springs of Water, but the most of them were either stinking or brackish tho recommended as excellent.[4] The

[1] These three mounts seem to have been the great *langi*, called Tuoteau, Katoa and Tuofefafa, with a smaller fourth one in front, unnoticed by Cook, called Tauatonga. Cook does not mention stone-work, apart from the wall, so the stone of the *langi* may have been heaped over with earth. These lay to the north of the eastern side of the great *mala'e*, and in front of them was a smaller *mala'e*. Within them were the stone vaults or burial chambers. The houses, *fakatolia*, were set up to protect the central part of the covering of fine black volcanic pebbles, called *kilitili*, which marked a vault. The information about the 'rude Images' being 'monuments' or commemorative figures was probably correctly gathered: cf. II, p. 251. The Tongans did not carve representations of their gods.

[2] No doubt a *matapule*, one of the non-chiefly but important officials on whom administration so much depended, attendant on a chief and sometimes his spokesman.

[3] By 'Lord of the Manor' Cook presumably means an '*eiki*, a great chief or 'noble', whose power, under that of the Tu'i Tonga, was territorial, as well as extending to the persons of the common people.

[4] Williamson, 20 June, provides a dissenting opinion: '. . . I have great reason to think that fresh water might be had by sinking a well at some distance from the lagoon, & am the more confirmed in this opinion from the many wells of delightful water, which we met with during our prerigrinations, some not less than thirty feet deep, & made extremely neat & clean.'

76: Yuncker N-4,5 (1953) 1959 OU9 Tonga OU9

Presumably, the unintentional introduction of certain weedy species occurred at the same time. A good many cultivated species, together with many weeds, owe their presence to the visits of European ships, starting early in the seventeenth century and continuing with increasing frequency to the present time. Some of these alien species find optimum conditions for growth and multiplication, and have undoubtedly played a part in limiting or even exterminating some endemics or indigenous species through aggressiveness. A high percentage of the usual strand and weed species includes those frequently found on other Pacific islands and elsewhere in tropical countries.

There is little fresh water available other than that impounded in tanks from rainfall. Aside from occasional small localized areas, the low coral islands present a monotonous repetition of plantation weeds and fallow-resting plantations of second-growth "bush." The dominant crop is coconuts, and large areas have been cleared for the extensive plantations found on most of the islands. At present, the high market value of copra makes it the most important source of income for the islanders. The second most important export crop is bananas, of which 50,000 or more cases are shipped annually to New Zealand. The more rugged topography of 'Eua, and to a somewhat lesser extent of Vava'u, prevents the cultivation of some parts of the islands. As a consequence, there are more opportunities on these islands for the survival of native species. Some of the islands, especially 'Eua and Kao, still have significant timbered areas with some of the tree species reaching a diameter of more than a meter and offering a source of timber. Lumbering operations are being developed by the government on 'Eua which, together with the fact that more and more of the forested land is being cleared for new plantations, threaten to reduce or eliminate many of the native species. Too, this has caused a soil erosion problem on some of the slopes. Lumbering operations on the volcanic islands of Late, Tofua, Kao, and Tafahi, because of the present lack of harbor facilities, are all but impossible. It seems improbable, therefore, that much timber will be cut on those islands in the immediate future, and it is on those islands that many of the native species will have the best chance of survival. However, with any marked increase in population, it will eventually become necessary to colonize and develop such islands.

The climate of Tonga is pleasant during most of the year. The annual temperature ranges from a low of around 75° F. in July and August to a high of 85° to 90° F. from January to March. Slightly higher or lower temperatures are not infrequent. The humidity is comparatively high, ranging from about 88° in the warmer months to a low of around 72° in the winter period. The average mean rainfall is about 80 to 90 inches, with the wettest season during the first six months of the year.

The collections upon which this report is based were made on the islands of Tongatapu, 'Eua, Nomuka, Lifuka, Kao, Vava'u and Niuafo'ou between February and June 1953. Projected visits to 'Ata, Tofua, and Late were aban-

76: Yuncker N-4,5 (1953) 1959 OU9 Tonga OU9

The flowers and the fruit are used for leis and ornamentation, and the wood for general construction purposes. [1]

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Hernandia ovigera Linnaeus, in Stickman, Herb. Amb., 14, 1754.

Medium to large tree, up to 20 m. or more tall. Leaves alternate, ovate, acute, peltate near base, entire, up to 20 cm. long and nearly as wide, five- to nine-nerved from petiole, petiole up to about as long as blade. Flowers monoecious, white, numerous in long-stalked, axillary and terminal, cymose clusters; fruit dry, somewhat ribbed, enclosed in an enlarged, fleshy, white or reddish, balloonlike vesicle with circumscissile opening.

Tongatapu: *Home.*

'Eua: in forest on seaward terrace near Lokupo, Mar. 27, 1953, *Yuncker 15533.*

Lifuka: in seaside thicket north of Pangai village, Apr. 24, 1953. *Yuncker 15711.*

Vava'u: *Crosby.*

Niuatoputapu: between Hihifo and Vaipoa, Dec. 7, 1951. *Hürlimann 373.*

Grows throughout Tonga, usually near the sea. From Indo-Malaysia to Polynesia.

H. peltata Meisn. in Hemsley's and Burkill's lists.

Tongan names: *fotulona, puko.*

The trunks are used for dugout canoes and the timber for banana shooks and general building purposes.

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Family CAPPARIDACEAE

Genus **Crataeva** Linnaeus

Crataeva religiosa Forster f., Pl. Esculent., 45, 1786.

Small tree. Leaves alternate, three-foliate, leaflets elliptic or elliptic-obovate, sharply acuminate, base wedge-shaped, entire, up to 15 cm. or more long and 7 cm. wide, thin, petiolules less than 1 cm. long, petiole up to 12 cm. or more long. Flowers four-parted, clustered toward ends of branches on slender pedicels up to 4 cm. long, petals spatulate, creamy white, spreading to about 5 cm. in width, gynophore slender, up to 4 or 5 cm. long.

Tongatapu: in clay soil in thicket near Bay of Mu'a by Pelehake, Aug. 10, 1953, *W. T. Ha'angana* [*Yuncker 16282*]. This is the only specimen known in Tonga and presumably was introduced.

From India to the Philippines and into Polynesia.

Genus **Capparis** Linnaeus

Capparis sandwichiana de Candolle, in DC. Prodr. 1: 245, 1824.

More or less prostrate, straggling or trailing shrub. Leaves alternate, oval or rounded, obtuse, base cordulate, entire, up to 4 cm. or more long, pinnately nerved, petiole slender, up to 4 cm. or more long. Flowers irregular, about 5 cm. wide, at first white, turning pink as they age, solitary, axillary, stamens numerous, ovary exserted on a long gynophore; fruit green, berrylike, ellipsoidal, about 5 cm. long, ridged, many-seeded, peduncle curved.

1 /Hernandia moerenhoutiana --Analyst/

76: Yuncker N-4,5 (1953) 1959 09 Tonga 009

Genus Albizzia Durazzini

Albizzia lebbeck (Linnaeus) Bentham, Hook. London Jour. Bot. 3: 87, 1844. 137

Tree, up to 8 or 12 m. tall. Leaves alternate, bipinnate, pinnae about six, up to 15 cm. long, leaflets six to eight, oblong, obtuse, base obtuse, asymmetrical, variable in size, up to 3-5 cm. long, subsessile, glabrous. Flowers yellowish, in headlike clusters up to 4 cm. in diameter; pods oblong, up to 20 cm. long and 3 cm. wide, flat, reticulate, impressed opposite seeds.

Tongatapu: in yard, Ma'ofanga, Nov. 23, 1951, *Hürlimann 321.*

Infrequent as a cultivated tree. A native of tropical Asia and Africa, now widely cultivated and naturalized.

Tongan name: *kasia.*

The timber is used for a variety of purposes. [313] [824]

Genus Acacia Willdenow

Acacia simplicifolia (Linnaeus f.) Druce, Bot. Exch. Cl. Brit. Isles, Rept. 4: 602, 1917.

Tree, up to 6-8 m. tall, glabrous. Leaves alternate, broadly elliptical or subovate, obtuse, base cuneate-decurrent, parallel-nerved, up to 10-12 cm. long and 8 cm. wide, petiole less than 1 cm. long, winged by decurrent blade margins. Flowers small, yellow, in axillary, headlike clusters 1 cm. or less in diameter; pods up to 12 cm. or more long, somewhat constricted between seeds.

Tongatapu: *Cook; Home;* in strand thicket along road to east of Nuku-'alofa, Feb. 27, 1953, *Yuncker 15100.*

'Eua: *Lister;* seaward margin of strand thicket, Ha'aluma, Apr. 1, 1953, *Yuncker 15590.*

Nomuka: in strand thicket above village, Apr. 30, 1953, *Yuncker 15866.*

Lifuka: along beach toward northern end of island, Apr. 25, 1953, *Yuncker 15745.*

Vava'u: *Crosby.*

Niuatoputapu: near shore at Hihifo, Dec. 6, 1951, *Hürlimann 370.*

A frequent strand species throughout Tonga. Samoa, Fiji, New Hebrides, and New Caledonia.

A. laurifolia Willd. in Hemsley's and Burkill's lists.

Tongan name: *tatangia.*

The wood is used in handicraft work. [313] [322] [824]

Genus Leucaena Bentham

Leucaena glauca (Linnaeus) Bentham, Jour. Bot. Hook. 4: 416, 1842.

Shrub or small tree, up to 5 or 6 m. tall, young growth puberulent. Leaves alternate, bipinnate, with five or six pairs of pinnae, leaflets numerous, oblong, acute, asymmetrical, sessile, 6-12 mm. long and about 2 mm. wide. Flowers small, white, in globose, headlike, axillary clusters, about 2.5 cm. in diameter, peduncle up to 4 or 5 cm. long; pods thin, flat, up to 15 cm. long and 1.5 cm. wide, seeds small, brown.

76: Yuncker N-4,5 (1953) 1959 OU9 Tonga OU9

137 Tongatapu: in thicket near sea, Sopu, Feb. 25, 1953, *Yuncker 15013.*

'Eua: in thicket northeast of Ohonua village, Apr. 2, 1953, *Yuncker 15625.*

Nomuka: in thicket on seaward side of road encircling island, Apr. 30, 1953, *Yuncker 15851.*

Vava'u: forming a large colony on seaside cliff along trail to Talau, west of Neiafu, May 23, 1953, *Yuncker 16145.*

Frequent throughout Tonga. A tropical American plant now of pantropic distribution.

Tongan name: *siale mohemohe.*

313 342 824 The timber is used for posts and in house construction.

Leucaena insularum (Guillemin) Daniker, Nat. Ges. Zürich, Vierteljahrschr. 77: Beibl. 19, 176, 1932.

Small tree, up to 5 m. or more tall, the young growth puberulent. Leaves alternate, bipinnate with eight or more pairs of pinnae, leaflets oblong, 45 or more on each pinna, acutish, obliquely inequilateral, up to about 7 mm. long, sessile. Flowers very small, pale pink, in globose, headlike, axillary, pedunculate clusters, peduncles up to 2 cm. or more long; pods slightly curved, up to 10 cm. or more long and 2 cm. wide.

Tongatapu: *Cook;* at shore north of Hofoa, Oct. 30, 1951, *Hürlimann 92;* near beach below Niutoua village, Mar. 2, 1953, *Yuncker 15108.*

'Eua: forming dense thicket along strand short distance above high-tide limit, Lokupo, Mar. 27, 1953, *Yuncker 15532.*

Lifuka: in thicket near beach at southern end of island, Apr. 28, 1953, *Yuncker 15791.*

Rather frequent throughout Tonga. Fiji, Niue, and New Caledonia.

L. forsteri Benth. in Hemsley's list.

Tongan names: *feifai, mohemohe.*

313 322 824 The timber is used in handicraft work.

Genus **Mimosa** Linnaeus

Mimosa pudica Linnaeus, Sp. Pl., 518, 1753.

Low, decumbent, subwoody, loosely branching, prickly plant. Leaves bipinnate, pinnae usually in one or two pairs, each with 15 or more pairs of linear-oblong leaflets up to 8 mm. or more long, acute, asymmetrical, sessile, sensitive. Flowers small, in globose, rose-pink, headlike, pedunculate, axillary clusters; the pod flat, thin, 1-2 cm. long, bristly.

Tongatapu: in waste area near Nualei, Oct. 29, 1951, *Hürlimann 45;* in grassy area near Niutoua village, Mar. 2, 1953, *Yuncker 15158.*

'Eua: *Lister.*

Vava'u: *Harvey, Crosby.*

A common weed in plantations, grazing areas and waste areas throughout Tonga. An American species now pantropic in distribution.

Tongan name: *mateloi.*

1 /Leucaena glauca -- Analyst/

76: Yuncker N-4,5 (1953) 1959 OU9 Tonga OU9

Genus **Adenanthera** Linnaeus

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Adenanthera pavonina Linnaeus, Sp. Pl., 384, 1753.

Medium to large tree. Leaves bipinnate with about 6 or 8 pinnae, each usually with 9-11 or more leaflets, the leaflets oval or oval-oblong, obtuse at both ends or the base subacute, up to 4.5 cm. long and 3 cm. wide, glabrous, the petiolules about 2 mm. long. Flowers small, greenish-white, short-pedicellate, in slender, spikelike, pedunculate, racemose clusters up to 15 cm. or more long, fragrant; pods up to 25 cm. or more long and 2 cm. wide, falcately curved, becoming spirally twisted upon opening, the seeds lens-shaped, bright red, shining, very uniform in size, ornamental.

Tongatapu: near village of Niutoua, Mar. 2, 1953, *Yuncker 15113.*

'Eua: along roadside near Houma village, Mar. 26, 1953, *Yuncker 15510.*

Niuafo'ou: behind Futu, Jan. 7, 1952, *Hürlimann 655.*

Occasional in or near villages throughout Tonga. An Indian species now pantropic in cultivation.

Tongan name: *loʻa.*

The wood is durable and used in handicraft work; the seeds, as beads for ornamentation.

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Genus **Entada** Adanson

Entada phaseoloides (Linnaeus) Merrill, Philippine Jour. Sci. 9C: 86, 1914.

Stout, glabrous, woody vine, climbing high in forest trees. Leaves alternate, evenpinnate, leaflets glossy, commonly four, asymmetrically oval-ovate, blunt or acute, obtuse or cordulate at base, up to 10 cm. long and 5 cm. wide but mostly smaller, venulose, petiolules up to 5 mm. long. Flowers very small, greenish, in long, axillary, short-pedunculate spikes up to 30 cm. long; pod very large, woody, up to 1 m. long and 10 cm. wide, seeds lens-shaped, brown, 3 cm. or more in diameter.

Tongatapu: near coast north of Fatai, Oct. 30, 1951, *Hürlimann 61;* climbing high in tree, along road between Lavengatonga village and sea, Mar. 7, 1953, *Yuncker 15188.*

'Eua: *Lister;* central valley between Pangai and Fuai, Nov. 10, 1951, *Hürlimann 230;* margin of forest near center of island, Mar. 18, 1953, *Yuncker 15321.*

Vava'u: *Crosby;* summit of Talau, west of Neiafu, May 24, 1953, *Yuncker 16156.*

Niuafo'ou: in thicket in interlava "island" on way to upper rim of main crater, May 16, 1953, *Yuncker 16006.*

Frequent in forested areas throughout Tonga. From Africa to southeastern Asia and Polynesia.

E. scandens Benth. in Hemsley's and Burkill's lists. See Johnson (Sargentia 8: 136-137, 1949) for an interesting discussion of this species.

Tongan names: *talai, faʻanga, lau faʻanga.*

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Genus **Maniltoa** Scheffer

137 **Maniltoa amicorum** A. C. Smith, sp. nov. (fig. 11).

Arbor ad 18 m. alta, trunco ad 75 cm. diametro, partibus inflorescentiae exceptis ubique glabra, ramulis gracilibus teretibus lenticellatis; foliis plerumque 9-12 (interdum 7-20) cm. longis 3-jugis vel apicem ramulorum versus 2-jugis raro 1-jugis, petiolis teretibus rugulosis 6-15 mm. longis, rhachi gracili, petiolulis ut petiolis rugulosis ad 4 mm. longis vel subnullis; laminis foliolorum subcoriaceis in sicco viridi-olivaceis inaequilateraliter ellipticis, (4-) 5-9 cm. longis, (2-) 3-5 cm. latis, basi obtusis, apice obtusis vel obtuse cuspidatis et leviter emarginatis, margine integris paullo recurvatis, costa supra leviter elevata subtus prominente, nervis secundariis principalibus utrinsecus 7-9 cum aliis interspersis marginem versus anastomosantibus et rete venularum conspicuo supra paullo subtus manifeste prominulis; inflorescentia apicem ramulorum versus axillari breviter racemosa circiter 15-flora juventute bracteis numerosis involucrata, bracteis papyraceis, maximis suborbiculari-obovatis ad 20×15 mm. apice rotundatis dorso copiose sericeo-puberulis (pilis pallidis 0.1-0.2 mm. longis) margine crispato-ciliolatis mox caducis, bracteis exterioribus minoribus glabrescentibus; rhachi sub anthesi 12-16 mm. longa basibus florum incrassata, bracteis floriferis medianis anguste obovatis 18-25 mm. longis 3-5 mm. latis apice rotundatis dorso ut bracteis majoribus pilosis, bracteolis lateralibus lineari-lanceolatis 5-6 mm. longis 0.5-1 mm. latis dorso in lineam medianam hispidulis mox caducis; pedicellis teretibus sub anthesi 10-13 mm. longis in receptaculum ad 3 mm. diametro incrassatis; sepalis 4 sub anthesi reflexis submembranaceis oblongis, 11-12 mm. longis, 3-6 mm. latis, apice obtusis; petalis 5 raro 6 membranaceis obovato-lanceolatis, sub anthesi 12.5-13.5 mm. longis 2-2.5 mm. latis, basi angustatis, apice subacutis; staminibus 35-40 plerumque 2-seriatis, filamentis teretibus 10-15 mm. longis, antheris oblongo-ellipsoideis 1.8-2 mm. longis apice obscure apiculatis; ovario stipitato sub anthese circiter 5×2.5 mm., ovulis 1 vel 2, stylo tereti 6-7 mm. longo inferne pilis castaneis paucis ad 1 mm. longis dorso crispato-piloso; legumine juvenili falcato-ellipsoideo ad 4×2.5 cm., utroque obtuso, pericarpio ruguloso.

'Eua: stately tree about 18 m. tall, trunk about 75 cm. in diameter, straight and free of branches below, with tender pink new growth appearing here and there from large buds, on side of ravine short distance northeast from village of Ohonua on western side of islands, Apr. 2, 1953, *Yuncker 15635*.

Vava'u: tree about 12 m. tall, trunk about 45 cm. in diameter, in open forest along upper rim of coastal limestone cliff on northwestern side of island, May 25, 1953, *Yuncker 16168* (type, in U.S. Nat. Herb., *nos. 2128567 and 2157730*); tree about 15 m. tall, trunk about 45 cm. in diameter, on forested slope above Lake Anovai, on southwestern side of island, May 19, 1953, *Yuncker 16040*.

"Vava'u and Lifuka": Aug.-Oct. 1855, *W. H. Harvey* (Gray Herb.).

Tongan names: *tamanu, pekepeka*.

[313] [824]

An excellent timber tree.

This is doubtless the plant listed as *Cynometra grandiflora* A. Gray by Hemsley (Linn. Soc. Bot., Jour. 30: 176, 1894) and Burkill (op. cit. 35: 35, 1901). It is closely related to two of the Fijian species of *Maniltoa* reviewed by me in 1950 (Jour. Arnold Arboretum 31: 166-171), *M. grandiflora* (A. Gray) Scheffer and *M. brevipes* A. C. Smith. Differences among these three species are mainly matters of degree, but it seems that the sum of their minor characters indicates the desirability of keeping them apart. From *M. grandi-*

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flora, the new species differs in the somewhat more prominent venation of its leaflets and in its more compact inflorescences, with the rachis and pedicels at anthesis being only about half as long (these parts in Gray's species being about 3 cm. and 2-2.5 cm. long respectively). The sepals of our species are slightly the shorter, as are the petals, filaments, and style (in *M. grandiflora* the petals are 12-19 × 3-4 mm., the filaments are 15-25 mm. long, and the style is 9-10 mm. long). Although in foliage, *M. amicorum* is essentially similar to *M. brevipes*, the venation of the leaflets is finer and more obviously prominulous beneath. The new species is further distinguished by having its bud-enclosing bracts sericeous-puberulent rather than glabrous dorsally, in the longer rachis of its inflorescence (about 1 cm. long in *M. brevipes*), in its shorter style, and in the larger bracts, both median and lateral, subtending the flowers.

Genus Tamarindus Linnaeus

Tamarindus indica Linnaeus, Sp. Pl., 34, 1753.

Medium to large, thickly branched, round-topped tree. Leaves alternate, even-pinnate, leaflets up to 36 or more on each pinna, opposite, oblong, obtuse or slightly emarginate, base obliquely inequilateral, about 2 cm. long and 5 mm. wide, sessile. Flowers yellow, striped with red, in axillary or terminal, racemose clusters; pods up to 12 cm. or more long, curved, seeds several, embedded in pulpy tissue.

Tongatapu: margin of coconut plantation below Nualei village, Mar. 9, 1953, *Yuncker 15237*.

Lifuka: northern margin of Pangai village, May 11, 1953, *Yuncker 15987*.

Vava'u: *Crosby*.

Occasional in villages. An African species now of wide distribution in tropical countries.

Tongan name: *tamaline*.

The pulpy part of the pod is edible.

Genus Intsia Thouars

Intsia bijuga (Colebrooke) O. Kuntze, Rev. Gen. Pl. 1: 192, 1891.

Rather large tree. Leaves alternate, even-pinnate, leaflets four, oval-ovate, obtuse or emarginate, base oblique, up to 8 or 10 cm. long and 5-7 cm. wide, glabrous, finely pinnately nerved, petiolules about 5 mm. long. Flowers about 1 cm. long, calyx puberulent, only one petal developing, petal pinkish, rounded; pod up to 20 cm. long and 6 cm. wide, coriaceous, seeds orbicular.

Kao: margin of forest near abandoned plantation, alt. about 30 m., May 6, 1953, *Yuncker 15957*.

Rare in Tonga. From Madagascar through Malaya and from the Philippines and the Caroline Islands eastward to Fiji and Samoa.

Tongan name: *fehi*.

The wood is very hard and is used in handicraft work.

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137 'Eua: *Lister:* in open woods along trail between Pangai village and Fuai, Mar. 25, 1953, *Yuncker 15484.*

Nomuka: along road encircling island, Apr. 30, 1953, *Yuncker 15830.*

Lifuka: side of road north of Pangai village, Apr. 25, 1953, *Yuncker 15740.*

Vava'u: *Crosby:* in clearing near coastal cliff along eastern side of island, below Houma village, May 22, 1953, *Yuncker 16128.*

Tafahi: beside road between township of Tafahi and landing place Faihavanui, Dec. 15, 1951, *Hürlimann 566.*

Niuatoputapu: on main mountain ridge above Vaipoa, to the east, Dec. 5, 1951, *Hürlimann 357;* plain southeast of Falehau, Dec. 7, 1951, *Hürlimann 380.*

Frequent throughout Tonga, Malaysia and Polynesia.

Tongan name: *ifi;* varietal names, *ifi mea, ifi 'ui, monosivai.*

[313] [412] [262] [824] The timber is strong and is used for general construction work, tool handles, tapa pounders, wooden drums, banana shooks, and so on. The fruit is edible.[1]

For a discussion of the reasons for using *I. edulis* as the correct name of this species rather than *I. fagiferus* (Parkinson) Fosberg, see Merrill (Chron. Bot. 14: 347, 1954).

Genus Abrus Linnaeus

Abrus precatorius Linnaeus, Syst., ed. 12, 472, 1767.

Subwoody, twining vine with slender, glabrous branches with long internodes. Leaves even-pinnate, alternate, leaflets subsessile, commonly 20 to 30, oblong, obtuse and slightly emarginate, base obtuse or cordulate, about 2 cm. long and 6 mm. wide. Flowers small, red or white, several, on very short, swollen, knoblike, terminal or axillary branches; pods several-seeded, seeds handsome, bright red with base black, shiny.

Tongatapu: *U.S. Expl. Exped.*

Lifuka: in seaside thicket toward northern end of island, Apr. 25, 1953, *Yuncker 15724.*

Kao: in thicket, margin of abandoned plantation, May 6, 1953, *Yuncker 15951.*

Vava'u: *Crosby;* in thicket near sea below Houma village, May 22, 1953, *Yuncker 16125.*

Niuafo'ou: in thicket in an interlaval "island" on way to upper rim of main central crater, May 16, 1953, *Yuncker 16002.*

Niuatoputapu: on edge of mountain range above Vaipoa, Dec. 5, 1951, *Hürlimann 353.*

Frequent in thickets throughout Tonga. A tropical Asiatic species now pantropic in distribution.

Tongan names: *matamoho, moho.*

[301] [824] The seeds are used for necklaces and other ornamentation.

1 /Inocarpus edulis -- Analyst/

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137 **Erythrina variegata** Linnaeus var. **orientalis** (Linnaeus) Merrill, Interpret. Herb. Amboin., 276, 1917.

Small to medium-sized, more or less spiny tree. Leaves alternate, trifoliate, long-petiolate, leaflets broadly triangular-ovate or rhombic, acute to acuminate, base truncate or acutish, up to 15 cm. long and nearly as wide, lower leaflets somewhat oblique, with prominent glands below base of petiolules. Flowers bright red, numerous, in dense, racemose clusters; pod up to 25 cm. or more long, seeds dark red.

Tongatapu: *U.S. Expl. Exped.;* in fence row near village of Niutoua, Mar. 2, *Yuncker 15115.*

'Eua: *Lister;* roadside near center of island, Mar. 19, 1953, *Yuncker 15364.*

Vava'u: in thicket near Houma village, May 22, 1953, *Yuncker 16136.*

Tafahi: near road between township of Tafahi and landing place Faihavanui, Dec. 15, 1951, *Hürlimann 543.*

Frequent throughout Tonga, often planted for use as living fence posts. India to Polynesia.

Tongan name: *ngatae.*

[396] [313] [415] [824] The trunks are used for making canoes, for general building purposes, and for banana shooks and the like.

Genus **Strongylodon** Vogel

Strongylodon lucidus (Forster f.) Seemann, Fl. Vit., 61, 1865.

Rather coarse, climbing, woody vine. Leaves alternate, three-foliate, leaflets glabrous, oval-ovate, entire, acuminate, base obtuse, three-nerved from base, midrib branched upward, lateral leaflets somewhat oblique, up to 10 cm. long and 6 cm. wide. Flowers red, beaked; pods flattened, thick, smooth, 10 cm. long and 5 cm. wide, seeds one or two, round, black.

'Eua: in southern part of eastern ridge near summit above Vaingana, Nov. 13, 1951, *Hürlimann 269.*

Infrequent. From Ceylon to the Hawaiian Islands.

Genus **Mucuna** Adanson

Mucuna gigantea (Willdenow) de Candolle, in DC. Prodr. 2: 405, 1825.

Rather slender, high-climbing, glabrous vine. Leaves alternate, three-foliate, long-petiolate, leaflets oval-ovate, lower two obliquely inequilateral, acuminate, base truncate or cordulate, up to 15 cm. or more long and 10 cm. wide, three-nerved from base, midrib branched upward, turning black upon drying. Flowers greenish, about 4 cm. long, long-pedicellate, in long-pedunculate, axillary, paniculate clusters; pods oblong, flattened, margin two-winged, covered with stinging hairs, up to 15 cm. or more long, seeds large, flattened, round or almost square.

Tongatapu: in forest tree along road between Lavengatonga village and sea, Mar. 6, 1953, *Yuncker 15187.*

'Eua: *Lister.*

Nomuka: in thicket near sea along road encircling island, Apr. 30, 1953. *Yuncker 15804.*

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nerved, with numerous fine, anastomosing nervules, petiolules up to 2.5 cm. long, petiole 5-7 cm. or more long. Flowers small, greenish orange, in branching, terminal clusters; fruit ovoid, drupaceous, 2 cm. or more long, seed edible. 137

'Eua: *Lister;* in thinly forested area back of Pangai village, on way to Fuai, Mar. 25, 1953, *Yuncker 15487;* in forest on eastern ridge above Fuai, alt. 150 m., Nov. 9, 1951, *Hürlimann 193.*

Vava'u: *Harvey; Crosby;* in forest at upper rim of coastal cliff along northwest coast, May 25, 1953, *Yuncker 16181.*

Occasional. Also known on Niue Island.

Tongan name: *'ai.*

Canarium samoense Engler, in DC. Monogr. Phanerog. 4: 134, 1883.

Large tree, up to 14 m. or more tall, bark and wood somewhat fragrant. Leaves alternate, pinnate, leaflets elliptic-lanceolate, acuminate, base acute, margin minutely uneven, pinnately nerved.

Kao: on steep rocky slope in open forest, about 180 m. alt., Apr. 30, 1953, *Yuncker 15966.*

This specimen is sterile and the report, which is new for Tonga, should be considered provisional. Also in Samoa.

Tongan name: *makai.*

The timber is used for canoe construction and in general building; the fragrant parts, for scenting oil. [396] [313] [303] [824]

Genus **Garuga** Roxburgh

Garuga floribunda Decaisne, Mus. Hist. Nat. Paris, Nouv. Ann. 3: 477, 1834.

Tree, up to 8 or 10 m. or more tall. Leaves alternate, hairy, pinnate, leaflets elliptic- or ovate-lanceolate, acuminate, base rounded, somewhat inequilaterally oblique, crenate-serrate, up to 13 cm. or more long and 5 cm. wide, pinnately nerved, petiolules scarcely 5 mm. long, petioles up to 8 cm. or more long. Flowers small, numerous, in paniculate clusters up to 15 cm. or more long, inflorescence parts puberulent; fruit 1 cm. or more thick.

Tongatapu: forest margin, below Niutoua village, Mar. 2, 1953, *Yuncker 15114;* near Nuku'alofa, 1926, *Setchell and Parks 15313.*

'Eua: clearing near Ohonua village, Apr. 2, 1953, *Yuncker 15634.*

Lifuka: near dwelling, Pangai village, Apr. 28, 1953, *Yuncker 15794.*

Vava'u: *Crosby 291;* in open forest near eastern coast below Houma village, May 22, 1953, *Yuncker 16129.*

Occasional throughout Tonga. Widespread from the Philippines and Java to Samoa, but not recorded from Fiji. Lam (Jard. Bot. Buitenzorg, Bull. III, 12: 329, 1932) indicates that *G. pacifica* Burkill (Linn. Soc. Bot., Jour. 35: 30, 1901) is to be reduced to the widespread *G. floribunda.*

Tongan name: *manaui.*

The timber is used in general construction work. [313] [824]

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Fuai plantation. Mar. 19, 1953, *Yuncker 15353;* on limestone cliff facing sea near summit of eastern ridge, Lokupo district, Apr. 8, 1953, *Yuncker 15674;* near eastern ridge cliff, alt. 220 m., Nov. 9, 1951, *Hürlimann 202.*

Kao: in open forest on lower slope, May 6, 1953, *Yuncker 15971.*

Vava'u: *Barclay; Crosby; MacDaniels;* in thicket on cliff near sea below Houma village. May 22, 1953. *Yuncker 16126.*

Frequent throughout Tonga. Limited to Fiji and Tonga.

Tongan names: *ahivao, takafalu'uli.*

Genus **Melia** Linnaeus

Melia azedarach Linnaeus, Sp. Pl., 384, 1753.

Small tree. Leaves alternate, twice-pinnate, leaflets ovate, acuminate, base acute, serrate, opposite, up to 5 cm. or more long, glabrous. Flowers numerous, small, in loose axillary panicles, fragrant, showy, corolla violet or lavender; fruit fleshy, subglobose, yellow, about 1.5 cm. in diameter.

'Eua: *Lister;* grove east of road between villages of Pangai and Ohonua, Apr. 2, 1953, *Yuncker 15631.*

Vava'u: *Crosby.*

Presumably introduced as an ornamental but occasionally adventive. A Chinese species widely planted in warm countries.

Tongan name: *sita.*

The wood is of some use for handicraft work.

Genus **Dysoxylum** Blume

Dysoxylum forsteri (Jussieu) C. de Candolle, in DC. Monogr. Phanerog. 1: 507, 1878.

Tree, up to 10 m. or more tall, young growth puberulent glabrescent. Leaves alternate, even-pinnate, up to 50 cm. or more long, leaflets oblong-elliptic or elliptic-lanceolate, acuminate, base inequilaterally oblique, up to 12 cm. long and 4-5 cm. wide, petiolules 2-3 mm. long. Flowers mostly less than 1 cm. long, sessile or short-pedicellate, in compound, racemose, axillary clusters, peduncle finely pubescent; fruit subglobose, about 2 cm. in diameter, brown with whitish scurfy patches.

Tongatapu: *Graeffe; Setchell and Parks; MacDaniels;* open forest near village of Niutoua, Mar. 2, 1953, *Yuncker 15117.*

'Eua: *Parks;* open forested area on seaward side of main road between villages of Pangai and Ohonua, Apr. 2, 1953, *Yuncker 15632.*

Nomuka: clearing on lakeward side of road encircling island, Apr. 30, 1953, *Yuncker 15860.*

Vava'u: *Barclay; Crosby;* about 1 mile along road leading to coastal cliff above Ha'alaufuli, May 21, 1953, *Yuncker 16111.*

Frequent throughout Tonga in open forested areas. Also in Niue.

D. richii (A. Gr.) DC. *sensu* Hemsley's list and Yuncker (B. P. Bishop Mus., Bull. 178: 71, 1943), not DC.

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Tongan name: *mo'ota.*

137 278 757 396 415 313 824

The plant parts[1] when crushed have a somewhat disagreeable odor said to resemble that of fruit bats (flying foxes). The leaves are used medicinally and an extract of the leaves is used for wetting tapas to cover the body "in cases of weakness." The wood is used in making canoes and banana shooks and for general building purposes.

Dysoxylum tongense A. C. Smith, U.S. Nat. Herb., Contrib. 30: 509, 1952.

Large tree, up to 10 m. or more tall, branchlets stout and with large, rounded leaf scars. Leaves even-pinnate, up to 25 cm. or more long, leaflets elliptic-ovate, acute, base obliquely inequilateral, up to 15 cm. long and 8 cm. wide, glabrous, pinnately nerved, petiolules about 1 cm. long. Flowers small, sessile, in axillary, paniculate clusters up to 12-14 cm. long, parts of inflorescence puberulent, corolla greenish white.

'Eua: *Parks;* in forest above Fuai plantation, Mar. 18, 1953, *Yuncker 15316;* edge of forest near center of island, Mar. 18, 1953, *Yuncker 15336;* Mar. 19, 1953, *Yuncker 15366;* Apr. 7, 1953, *Yuncker 15662.*

So far as I know, this species is restricted to 'Eua Island above about 100 m. altitude.

Tongan name: *mo'ota kula.*

313 322 824

The wood is used in handicraft work.

Genus **Aglaia** Loureiro

Aglaia heterotricha A. C. Smith, U.S. Nat. Herb., Contrib. 30: 486, 1952.

Tree with slender branches, branchlets, petioles, and lower leaflet surface scaly-hairy. Leaves odd-pinnate, leaflets seven, elliptic, up to 25 cm. long and 10 cm. wide, obtuse, base obtuse or acute, petiolules up to 17 mm. or more long, petiole 15-20 cm. long, conspicuously swollen at base. Flowers about 2 mm. long, on slender, short pedicels, in freely branched, axillary, paniculate clusters, the stamen filaments united into a pilose tube.

'Eua: central plateau, June or July 1926, *Parks 16305,* type collection. Known only from 'Eua.

Aglaia saltatorum A. C. Smith, U.S. Nat. Herb., Contrib. 30: 483, 1952.

Shrub or tree, up to 10 m. tall, twigs and young parts pubescent, hairs brown, stellate. Leaves odd-pinnate, leaflets mostly seven, essentially opposite, elliptic or oblong-elliptic, apex acute or rounded, base inequilateral, obtuse or acute, up to 15 cm. long and 8 cm. wide, pinnately nerved. Flowers small, about 2 mm. long, numerous, in rather large, axillary, paniculate clusters; fruit subglobose or ellipsoidal, about 2 cm. long, brown, stellately pubescent.

Tongatapu: *Setchell and Parks; McKern;* in seaside forest below village of Niutoua, Mar. 2, 1953, *Yuncker 15138.*

'Eua: in rich forest above Fuai plantation, Mar. 18, 1953, *Yuncker 15313.*

Nomuka: above village in clearing near sea, Apr. 30, 1953, *Yuncker 15857.*

Lifuka: along road north of Pangai village, Apr. 25, 1953, *Yuncker 15738.*

Vava'u: *Crosby.*

Niuatoputapu: on coral soil near dwelling, Jan. 2, 1952, *Hürlimann 649.*

[1] /Dysoxylum forsteri -- Analyst/

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Vava'u: *Crosby.*

Niuafo'ou: thicket just above upper margin of recent lava flow, May 16, 1953, *Yuncker 15989.* 137

Frequent throughout Tonga. New Hebrides eastward to [?] Samoa.

Phyllanthus ramiflorus Muell. Arg. in Hemsley's list and *P. ramiflorus* var. *genuinus* Muell. Arg. in Burkill's list.

Tongan names: *malolo, misikoka.*

The leaves and bark are used in preparing medicines. 1 [278] [824] [113]

For a discussion of the taxonomic status and distribution of *G. concolor* and *G. ramiflorum* see Croizat (Sargentia 1: 47, 1942).

Genus **Bischofia** Blume

Bischofia javanica Blume, Bijdr. Fl. Java, 1168. 1826.

Tree, up to 10 m. or more tall, branchlets and leaves glabrous. Leaves alternate, three-foliate, leaflets ovate-eliiptic, acuminate, base acute, up to 15 cm. long and 8 cm. wide, crenate-dentate, terminal leaflet long-stalked, lateral leaflets on petiolules 1-1.5 cm. long. Flowers small, dioecious, numerous, in axillary, panicled racemose clusters; fruit globose, fleshy, up to about 1 cm. in diameter.

Tongatapu: *Moseley;* thicket near Hufangalupe, Feb. 26, 1953, *Yuncker 15042;* near dwellings, Ma'ofanga, Nov. 23, 1951, *Hürlimann 313;* near Nualei, Dec. 26, 1951, *Hürlimann 677.*

'Eua: in forested area near center of island, Mar. 18, 1953, *Yuncker 15313;* in forest along creek above Fuai, alt. 90 m., Nov. 8, 1951, *Hürlimann 164.*

Nomuka: thicket near shore of lake, along road encircling island, Apr. 30, 1953, *Yuncker 15856.*

Lifuka: in thicket between road and beach, north of Pangai village, Apr. 25, 1953, *Yuncker 15715.*

Vava'u: *Crosby;* in thicket along road between Houma village and sea, May 22, 1953, *Yuncker 16122.*

Common throughout Tonga. India, China, and Malaysia to Polynesia.

[?] Including *B. leptopoda* Muell. Arg. *sensu* Hemsley's list.

Tongan name: *koka.*

The bark furnishes a dye used in coloring tapa; the stems are used for posts and so forth. [386] [313] [417] [824]

Genus **Claoxylon** Jussieu

Claoxylon parvicoccum Croizat, Sargentia 1: 49, 1942.

Tree up to 8 m. or more tall, the branchlets and leaves glabrous. Leaves alternate, elliptic-ovate, acuminate, the base acute to long-cuneate, 12-15 cm. or more long and 5-8 cm. wide, sharply crenately toothed, pinnately nerved, the petiole up to 8 cm. or more long. Flowers unisexual, in slender, spicate clusters.

1 /Glochidion ramiflorum -- Analyst/

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137 'Eua: *Parks 16262* [cited by Croizat]; forested area near center of island, Mar. 18, 1953, *Yuncker 15322.*

Infrequent. Also in Fiji.

Genus **Macaranga** Thouars

Macaranga harveyana (Mueller-Argoviensis) Mueller-Argoviensis, in DC. Prodr. 15(2): 998, 1866.

Small, soft-wooded, dioecious tree, up to 8 m. or more tall, branchlets stout, pithy. Leaves alternate, peltate, round-ovate, acuminate, very shallowly toothed or entire, paler and golden glandular-dotted beneath, about eight-nerved from petiole, midrib branched upward, up to 20 cm. or more long and 18 cm. wide, commonly somewhat smaller, petioles up to 15 cm. or more long, stipules lanceolate, long-acuminate, up to 2 cm. long. Flowers small, in axillary, paniculate-racemose clusters; fruit depressed-globose, soft-spiny, about 1 cm. in diameter.

Tongatapu: *Moseley;* thicket along road near Vaini village, Feb. 26, 1953, *Yuncker 15053* (male), *15065* (female).

'Eua: *Lister;* margin of old plantation between Pangai village and Fuai, Mar. 25, 1953, *Yuncker 15482.*

Lifuka: thicket near northern end of island near Lifuka end of interisland causeway, May 11, 1953, *Yuncker 15980.*

Kao: lower margin of forest near old plantation, May 6, 1953, *Yuncker 15960.*

Vava'u: *Crosby;* in clearing on slope above the lagoon at Vaihoi, May 26, 1953, *Yuncker 16200.*

Tafahi: forest along path to Piu 'o Tafahi, alt. 150 m., Dec. 10, 1951, *Hürlimann 406.*

Frequent throughout Tonga. Fiji, Niue, and Samoa to the Society Islands.

Tongan name: *loupata.*

313 342 322 415 The timber is used for house construction, handicraft work, banana shooks, and other purposes; the leaves, for covering *umu* (ovens), for wrapping fish, and in medicines used for stomach disorders in infants.

251 278 854 824 **Macaranga seemannii** (Mueller-Argoviensis) Mueller-Argoviensis, in DC. Prodr. 15(2): 999, 1866.

Tree up to 18 m. tall, branchlets and petioles subglabrous. Leaves alternate, broadly ovate, long-acuminate, base rounded, peltate 2.5-7.5 cm. from margin, six- to eight-nerved from petiole, glandular beneath, nerves beneath puberulent, up to 30 cm. long and 22 cm. wide but commonly somewhat smaller, petiole up to 18 cm. long, stipules oblong-lanceolate, up to 4 cm. long and 1 cm. wide. Flowers small, in axillary, paniculate clusters up to 12 cm. long; fruit smooth, glandular.

Tongatapu: *Cook; U.S. Expl. Exped.*

Infrequent. Also in Fiji.

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Genus **Securinega** Jussieu

137 **Securinega samoana** Croizat, B. P. Bishop Mus., Bull. **184**: 45, 1945.

Small to medium-sized tree up to 10 m. tall. Leaves alternate, elliptic or elliptic-subobovate, glabrous, acuminate, base subacute, pinnately nerved, nerves six to eight on each side, up to 12 cm. or more long and 6 cm. wide, on petioles scarcely 1 cm. long. Flowers white, very small, numerous, on pedicels about 5 mm. long, in axillary clusters; fruit black.

Tafahi: in forest along road between township of Tafahi and landing place at Faihavanui, alt. 100 m., Dec. 15, 1951, *Hürlimann 562.*

Niuatoputapu: in forest, slope of ridge above Hihifo, alt. 60 m., Dec. 5, 1951, *Hürlimann 339.*

Known in Tonga from only the northernmost islands. Samoa.

Tongan name: *poumuli.*

824 342 313 The timber is very hard and is used for various purposes, including house construction.

Family ANACARDIACEAE

Genus **Mangifera** Linnaeus

Mangifera indica Linnaeus, Sp. Pl., 200, 1753.

Large, dense, round-topped tree. Leaves alternate, simple, oblong-lanceolate, acute, coriaceous and somewhat shiny, pinnately nerved, midrib prominent, young leaves often reddish, petioles up to 5 cm. or more long. Flowers small, yellowish white, in large, terminal panicles; fruit a fleshy, edible drupe with a large, compressed, fibrous stone.

Tongatapu: roadside south of Ma'ofanga, Nov. 23, 1951, *Hürlimann 320.*

Introduced for its fruit and common about villages throughout Tonga, this tree grows spontaneously in thickets, along roadsides, and so forth. A tropical Asiatic species now cultivated in tropical regions throughout the world.

137 262 Tongan name: *mango.* The following varieties are recognized:

Mango kaimata: fruit is sweet and edible before it is fully ripened. Various forms of this variety are based on the size of the fruit.

Mango kalasini: fruit has an odor resembling kerosene.

Mango lesi: fruit is of medium size and of the best quality. Three or four forms of this variety are recognized.

Mango uni: fruit is very large.

Genus **Spondias** Linnaeus

137 **Spondias dulcis** Parkinson, Jour. Voy. Endeavour, 39, 1773.

Medium to large, stiff-branched tree, up to 15 m. or more tall. Leaves alternate, odd-pinnate, leaflets commonly 11 to 15, oval-lanceolate or oblong, acuminate, base acute, remotely finely toothed, up to 8 cm. or more long and 2.5 cm. wide. Flowers small, numerous, whitish, in large, paniculate clusters; the fruit yellow, oval-obovate, up to 7 cm. or more long, fleshy, edible.

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Tongatapu: *Forster; U.S. Expl. Exped.;* in forest near Nualei, south of Nuku'alofa, Mar. 9, 1953, *Yuncker 15244;* near house, Ma'ofanga, Nov. 23, 1951. *Hürlimann 311.* 137

'Eua: *Lister;* in Ohonua village, Apr. 2, 1953, *Yuncker 15636.*

Of early introduction. Malaysia to Polynesia.

Tongan name: *vi.*

The timber[1] is used for general building purposes, and large trunks are used for dugout canoes. [824] [394] [313]

Genus **Pleiogynium** Engler

Pleiogynium solanderi (Bentham) Engler. in DC. Monogr. Phanerog. 4: 255, 1883.

Medium to large tree up to 10 m. or more tall. Leaves alternate, odd-pinnate, leaflets seven to nine, obliquely elliptic or elliptic-ovate, acuminate, base acute and narrowly decurrent on petiolules, up to 10 cm. or more long, pinnately nerved, petiolules mostly scarcely 1 cm. long. Flowers small, densely clustered on rather short, axillary clusters; fruit turbinate, about 2.5 cm. in diameter, broadly grooved.

'Eua: margin of forest near center of island, Mar. 18, 1953, *Yuncker 15332;* in seaward forest on terrace above Houma village, Mar. 26, 1953, *Yuncker 15507.*

Vava'u: *Crosby;* on seaward face of coastal cliff above Ha'alaufuli, May 21, 1953, *Yuncker 16114.*

Occasional. From tropical Australia to Polynesia.

Tongan name: *tangato.*

An excellent timber tree. [824] [313]

Genus **Rhus** Linnaeus

Rhus taitensis Guillemin, Ann. Sci. Nat. Bot. II, 7: 361, 1837.

Medium to large forest tree with young parts more or less puberulent. Leaves large, alternate, odd-pinnate, leaflets up to 19 or more, oblong, bluntly pointed, base obliquely inequilateral, up to 10 cm. or more long, short-petiolulate. Flowers small, white, numerous, in large, terminal, compound clusters 30 cm. or more long.

Tongatapu: *U.S. Expl. Exped.;* open forest near Vaini village, Feb. 26, 1953, *Yuncker 15066;* forest, terrace below Fu'amotu, Nov. 3, 1951, *Hürlimann 139.*

'Eua: *Lister;* open forest near center of island, Mar. 19, 1953, *Yuncker 15365.*

Lifuka: clearing near center of island, infrequent, Apr. 27, 1953, *Yuncker 15773.*

Kao: lower margin of slope forest, May 6, 1953, *Yuncker 15972.*

Vava'u: *Crosby.*

1 /Spondias dulcis -- Analyst/

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137 Niuatoputapu: in forest, top of mountains above Hihifo, alt. 100 m., Dec. 5, 1951, *Hürlimann 346.*

Frequent throughout Tonga. Philippines to Polynesia.

Tongan name: *tavahi.*

[824 313 278] The timber is used for general construction purposes, banana shooks, and so on; the leaves, in medicines.

Family CELASTRACEAE

Genus **Gymnosporia** Wight and Arnott

Gymnosporia vitiensis (A. Gray) Seemann, Fl. Vit., 40, 1865.

Scrambling, much-branched shrub or small tree up to 4 m. tall, the twigs angled. Leaves alternate, oval, obtuse or subacute, base wedge-shaped, minutely toothed, up to 8 or 9 cm. long and 5 cm. wide, pinnately nerved, petioles up to 1 cm. long. Flowers white, about 5 mm. wide, five-parted, on slender pedicels in the axils of small, fimbriate-ciliate bracts, in terminal or axillary, paniculate clusters; fruit three-celled, red, seeds red.

Tongatapu: *Nelson.*

'Eua: *Lister;* sea-facing side of limestone cliff near summit of eastern ridge, Apr. 8, 1953, *Yuncker 15675;* forest near center of island, Apr. 6, 1953, *Yuncker 15651;* seaward terrace above village of Honuma, Mar. 26, 1953, *Yuncker 15502;* little valley on eastern ridge, plateau above Fuai, Nov. 9, 1951, *Hürlimann 189.*

Nomuka: along road encircling island between sea and inland lake, Apr. 30, 1953, *Yuncker 15834.*

Vava'u: *Crosby;* seaward face of limestone coastal cliff above Leimatua, May 20, 1953, *Yuncker 16056;* upper rim of steep seaside cliff above Ha'alaufuli, May 21, 1953, *Yuncker 16086;* sprawling on side of rocky cliff near sea below Houma village, May 22, 1953, *Yuncker 16132.*

Common and widely distributed throughout Tonga. Fiji and eastward in Polynesia to Samoa, Society Islands, and the Marquesas.

Tongan name: *olamaka.*

[824 352] The long, pliable branches are used in making chairs.

Family ICACINACEAE

Genus **Citronella** D. Don

Citronella samoensis (A. Gray) Howard, Jour. Arnold Arboretum 21: 475. 1940.

Tree with diffuse top, up to 6 m. or more tall. Leaves leathery, glossy, oval-ovate, acuminate, base acute, entire, up to 15 cm. or more long and 8 cm. wide, pinnately nerved, lateral nerves submarginally loop-connected, petioles 1-2 cm. long, canaliculate. Flowers small, in few-flowered clusters in a terminal racemose cluster up to 15 cm. long; fruit ellipsoidal, about 2-3 cm. long, black.

1 /Rhus taitensis -- Analyst/

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137 Tongatapu: *Forster;* forest near village of Niutoua, Mar. 2, 1953, *Yuncker 15168.*

'Eua: open forest along trail between Pangai village and Fuai, Mar. 25, 1953, *Yuncker 15486.*

Vava'u: *Crosby.*

Niuatoputapu: near township of Vaipoa, on road to Falehau, alt. 5 m., Dec. 7, 1951, *Hürlimann 377.*

Occasional throughout Tonga. Malaya, New Guinea, and Polynesia.

Tongan name: *tava.*

Varieties are recognized under the following names: *tava kula, tava moli, tava toua.*

[824] [313] [342] [262] [278] The timber[1] is used in house construction, for tapa pounders, for banana shooks, and so on; the fruit is sometimes eaten; and the bark is used in medicine for "stomach troubles."

Genus Guioa Cavanilles

Guioa lentiscifolia Cavanilles, Icones Descr. Pl. 4: 50, pl. 373, 1797.

Small tree 3-5.5 m. tall, young twigs, leaves, and so forth puberulent. Leaves alternate, pinnately compound, leaflets varying in number, apex rounded, obtuse to acute, base narrowed and decurrent on very short petiolule, up to 6 cm. long and 3 cm. wide but mostly smaller, pinnately nerved, midrib prominent, lateral nerves slender, submarginally loop-connected. Flowers small, white, in terminal and axillary, paniculate clusters; fruit strongly lobed, up to 2 cm. wide.

'Eua: seaward margin of forest on terrace above village of Houma on northwestern side of island, alt. about 160 m., Mar. 26, 1953, *Yuncker 15503;* thicket, edge of forest above Fuai plantation, near center of island, Mar. 29, 1953, *Yuncker 15545.*

Vava'u: near upper rim of seaside cliff above Ha'alaufuli on northeastern side of island, alt. about 120 m., May 21, 1953, *Yuncker 16106.*

Tongan name: *'olive.*

[113] The cited specimens certainly appear to represent the endemic described and illustrated by Cavanilles and further briefly discussed by Radlkofer (Sitzber. Math.-Phys. Kl. Akad. Wiss. München 9: 608, 1879; Pflanzenr. 98 [IV. 165]: 1158, 1933). It may be noted that Radlkofer defines *Guioa* as having squamate petals, but Cavanilles gives no indication of this character in his description or plate, and the material now dissected (*Yuncker 15503*) shows the petals to be esquamate. As *G. lentiscifolia* is the genotype, a revision of Radlkofer's circumscription is a matter for the future monographer to consider. Actually, on the basis of other characters, the many species now referred to *Guioa* seem correctly placed, but less dependence upon petal characters may [113] be indicated. Possibly this is the species listed by Hemsley (Linn. Soc. Bot. Jour. 30: 172, 1894) and Burkill (op. cit. 35: 33, 1901) as *Guioa glauca*

1 /Pometia pinnata -- Analyst/

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(Labillardière) Radlkofer; but that species is apparently limited to New Caledonia, in spite of Radlkofer's inclusion in its synonymy of the mysterious Tongan "*Guaiacum dubium* Forst. f." 137

Guaiacum dubium Forst. f. (Fl. Ins. Australia, Prodr., 32, 1786) was originally described as "Foliis coniugatis oblongolanceolatis obtusis." Fortunately a photograph of Forster's specimen in the British Museum (Natural History) is available, through the kindness of Dr. G. Taylor, and it indicates that the very poor specimen is a mixture. The detached fruits seem to represent a species of *Guioa*, very likely *G. lentiscifolia*, whereas the leaves (mostly detached) apparently do not represent Sapindaceae. For the time being, no alternative suggestion can be made. The name may thus be rejected under Article 76 of the International Code (1952). Certainly the epithet should not be used to replace either *G. lentiscifolia* or *G. glauca* (A. C. Smith). [113]

Genus **Elattostachys** Radlkofer

Elattostachys falcata (Seemann) Radlkofer, Sapindaceen Höll.-Ind., 42, 1877.

Large forest tree. Leaves alternate, pinnate, leaflets 10 or more, falcately lanceolate, acuminate, base obliquely inequilateral, entire, up to 15 cm. long and 5 cm. wide, somewhat coriaceous, petiolules up to about 1 cm. long. Flowers white, small, in terminal or axillary, paniculate clusters.

Tongatapu: *Moseley;* open forest, roadside below village of Niutoua, Mar. 2, 1953, *Yuncker 15120;* in coastal forest near Ha'akame village, Mar. 12, 1953, *Yuncker 15270, 15277.*

'Eua: in forest above Fuai plantation, near center of island, Mar. 18, 1953, *Yuncker 15315.*

Kao: open forest on steep, rocky slope, May 6, 1953, *Yuncker 15898.*

Vava'u: *Crosby;* near upper rim of steep seaside cliff, above Ha'alaufuli, May 21, 1953, *Yuncker 16100.*

Niuafo'ou: forest, slope above great lake, toward Futu, alt. 20 m., Jan. 7, 1952, *Hürlimann 669.*

Tafahi: forest, below township of Tafahi toward Hou, alt. 20 m., Dec. 17, 1951, *Hürlimann 583.*

Frequent throughout Tonga in forested areas. Also in Fiji, Niue, and Samoa.

Ratonia falcata Seem., and probably also as *R. stipitata* Benth., in Hemsley's list.

Tongan name: *ngatata.*

The tree furnishes a good timber for general construction purposes, for banana shooks, for handicraft work, and other objects. [824] [313]

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Genus **Alphitonia** Reissek

137 **Alphitonia zizyphoides** (Solander) A. Gray, U.S. Expl. Exped., Bot. 1: 278, pl. 22, 1854.

Medium to large tree with young branches brown-tomentose. Leaves alternate, elliptic-lanceolate, acute, base rounded, obtuse or acutish, up to 15 cm. or more long and 5 cm. wide, pinnately nerved, nerves prominent, bright green above, whitened-tomentose beneath, petioles 1-2 cm. long. Flowers small, whitish, numerous, in branching, axillary, and terminal, cymose clusters; fruit about 5 mm. in diameter, purplish.

Tongatapu: *U.S. Expl. Exped.; Home;* forest near sea, vicinity of Niutoua village, Mar. 2, 1953, *Yuncker 15121.*

'Eua: *Lister;* summit of eastern ridge above Fuai, Nov. 9, 1951, *Hürlimann 199;* open forest near center of island, Mar. 19, 1953, *Yuncker 15360.*

Nomuka: clearing along road encircling island between sea and central lake, Apr. 30, 1953, *Yuncker 15819.*

Lifuka: roadside, between Pangai village and southern end of island, Apr. 28, 1953, *Yuncker 15784.*

Kao: lower margin of slope forest, May 6, 1953, *Yuncker 15962.*

Vava'u: *Crosby;* upper slope of Talau, west of Neiafu, May 24, 1953, *Yuncker 16153.*

Tafahi: along road from township of Tafahi toward Taihavanui, Dec. 15, 1951, *Hürlimann 567.*

Frequent throughout Tonga. From Sumatra and the Philippines eastward to Polynesia.

A. excelsa Reiss. in Hemsley's and Burkill's lists.

Tongan name: *toi.*

[824] [313] [396] [278] [515] This tree provides an excellent grade of timber useful in construction work and for dugout canoes, poi pounders, banana shooks, and the like. The bark is used in preparing medicines, and the leaves may be used as a soap substitute.

Family ELAEOCARPACEAE

Genus **Elaeocarpus** Linnaeus

Elaeocarpus tonganus Burkill, Linn. Soc. Bot., Jour. 35: 29, 1901.

Medium-sized tree up to 10 m. or more tall. Leaves alternate, elliptic or elliptic-ovate, acuminate, base acutish or obtuse, crenulate, up to 12 cm. or more long and 6 cm. wide, pinnately nerved, petiole slender, up to 4 or 5 cm. long. Flowers less than 1 cm. long, in simple, mostly axillary racemes up to 5 cm. or more long, pedicels up to 1.5 cm. long, inflorescence silky-hairy; fruit ellipsoidal, up to 1.5 cm. long.

'Eua: in forest near summit of eastern ridge, Mar. 30, 1953, *Yuncker 15554* [a juvenile specimen, presumably this species].

Vava'u: *Crosby 15* [type]; edge of forest above Leimatua, May 20, 1953. *Yuncker 16055;* on steep slope leading to lagoon at Vaihoi, below Leimatua. May 26, 1953, *Yuncker 16183.*

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137 *G. mallococca* L. f. in Hemsley's and Burkill's lists.

Tongan name: *fo'ui.*

[824 313 283] The timber[2] is used for banana shooks and the bark fibers for cordage.

Grewia prunifolia A. Gray, U.S. Expl. Exped., Bot. 1: 199, 1854.

Shrub. Leaves alternate, ovate or lanceolate, acuminate, base rounded, 5-8 cm. long, finely serrulate, three-nerved from base, midrib pinnate above, glabrous, petioles scarcely 1 cm. long. Flowers one to three on short, axillary peduncles, less than 1 cm. wide; fruit four-lobed, somewhat hirsute.

Tongatapu: *Moseley.* Also in Fiji.

Genus **Triumfetta** Linnaeus

Triumfetta bartramia Linnaeus, Syst., ed. 10, 1044, 1759.

Densely stellate-hairy, half-woody, branching, shrublike plant up to 2 m. or more tall. Leaves alternate, round-ovate, mostly three-lobed, lobes acuminate, serrate, base rounded, cordulate, up to 8 cm. or more long and 7 cm. wide, palmately five- to seven-nerved, petiole slender, up to 6 cm. or more long. Flowers small, yellow, in compact, axillary fascicles; fruit subglobose, about 5 mm. in diameter, covered with hooked bristles.

Tongatapu: waste area near Blow Hole area below Houma village, June 1, 1953, *Yuncker 16218.*

Lifuka: old plantation near southern end of island, Apr. 28, 1953, *Yuncker 15786.*

Vava'u: *Crosby.*

Tafahi: plantation above township of Tafahi, alt. 70 m., Dec. 15, 1951. *Hürlimann 526.*

Frequent as a plantation and waste-area weed throughout Tonga. Pantropic.

T. rhomboidea Jacq. in Burkill's list.

Tongan names: *mo'osipo, mo'osipo enge'enga.*

Triumfetta procumbens Forster f., Fl. Ins. Australia, Prodr., 35, 1786.

Prostrate, semi-woody plant with long, trailing, densely stellate-pubescent branches. Leaves simple, alternate, round-ovate in outline, rounded-cordate at base, commonly three-lobed, lobes obtuse, crenate-serrate, up to 6 cm. or more long and as wide, palmately five- to seven-nerved, petioles as long as or exceeding blade. Flowers about 1 cm. long, yellow, in axillary, pedunculate, umbellate clusters, fruit globose, about 12 mm. in diameter, covered with pubescent bristles.

Tongatapu: *Mathews; Home; Graefe;* in sand near sea below village of Fu'amotu, Mar. 4, 1953, *Yuncker 15165;* on sand at upper edge of beach below steep cliff near Haveluliku village, June 3, 1953, *Yuncker 16234.*

'Eua: pioneering in sand, margin of seaside thicket just above high-tide limit, Ha'aluma, Apr. 1, 1953, *Yuncker 15601.*

Vava'u: *Crosby.*

Tafahi: on shore below township of Tafahi, Dec. 13, 1951, *Hürlimann 492.*

1 /Grewia crenata -- Analyst/

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137 215 824

Occasional[1] in villages as an ornamental. A native of tropical Africa now widely cultivated in warm countries.

Hibiscus syriacus Linnaeus, Sp. Pl., 695, 1753.

Erect, branching, glabrous shrub 2 m. or more tall. Leaves rhombic-ovate, alternate, lower ones often three-lobed, toothed, acute to acuminate. Flowers up to 8 cm. wide, red or purplish, solitary in leaf axils on current season's growth; fruit ovoid, up to 2.5 cm. long.

Introduced ornamental. Occasional. A Chinese species now of worldwide cultivation in tropical and temperate countries.

Hibiscus tiliaceus Linnaeus, Sp. Pl., 694, 1753.

Tree up to 8 m. or more tall with glabrous or somewhat pubescent, spreading branches. Leaves round-ovate, abruptly acuminate, base deeply cordate with a narrow sinus, up to 15 cm. or more long and nearly as wide, palmately seven- to nine-nerved, glabrescent above, paler and densely stellate-pubescent beneath, petioles up to 12 or 15 cm. long. Flowers up to 10 cm. wide, on short, axillary and terminal pedicels, corolla yellow with darker eye, turning salmon red; capsule pubescent, five-celled, several-seeded, seeds glabrous.

Tongatapu: thicket near beach, Sopu, west of Nuku'alofa, Feb. 25, 1953, *Yuncker 15027.*

'Eua: *Lister;* in thin forest below Fuai plantation, near center of island, Mar. 19, 1953, *Yuncker 15358.*

Lifuka: in seaside thicket just above high-tide limit, north of Pangai village, Apr. 25, 1953, *Yuncker 15742.*

Vava'u: *Harvey; Crosby.*

Tafahi: coastal forest, below township of Tafahi, Dec. 13, 1951, *Hürlimann 490.*

Frequent throughout Tonga, usually near the shore. Pantropic.

Tongan name: *fau.*

824 283 313 278 757

The bark fibers are used in making cordage, mats, *tauvale,* kava filters, and so forth. The wood is used in general construction work and fences; the bark and young leaves, in the treatment of skin diseases.

Genus **Thespesia** Solander

Thespesia populnea (Linnaeus) Solander, ex Correa, Mus. Nat. Hist. Nat. Paris, Ann. 9: 290, 1807.

Medium-sized, round-topped tree, the young branches brown-scurfy. Leaves simple, alternate, somewhat fleshy, ovate, acuminate, base cordate with an open sinus, entire or rarely somewhat lobed, palmately five- to seven-nerved, up to 12 cm. or more long and 10 cm. wide, petioles up to 10 cm. or more long. Flowers up to 8 or 10 cm. wide, solitary, on stout, axillary pedicels, corolla yellow with reddish center, changing to purple with age; capsules depressed-globose, about 2.5 cm. in diameter, seeds 10, hairy.

Tongatapu: seaside thicket near Niutoua village, Feb. 27, 1953, *Yuncker 15107.*

1 /Hibiscus schizopetalus -- Analyst/

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'Eua: *Lister;* deep ravine northeast of Ohonua village, Apr. 2, 1953, *Yuncker 15629.*

Lifuka: near sea north of Pangai village, Apr. 25, 1953, *Yuncker 15746.*

Vava'u: *Crosby.*

Tafahi: coastal forest, near Hou, alt. 5 m., Dec. 17, 1951, *Hürlimann 586.*

Frequent near the shore throughout Tonga. Pantropic.

Tongan name: *milo.*

The leaves and fruit are used in preparing medicines. The timber takes a good polish, is durable under water, and is used in construction and handicraft work.

Genus **Gossypium** Linnaeus

Gossypium brasiliense Macfayden, Fl. Jamaica 1:72, 1837.

Semi-shrubby, branching plant, up to 1.5 m. or more tall. Leaves alternate, round-ovate in outline, three- to five-lobed, lobes entire, on long petioles. Involucral bracts cordate, laciniate, acuminate, seeds numerous, covered with long, white fibers.

Vava'u: *Crosby.*

Introduced and occasional in villages. Pantropic.

Tongan name: *tavae.*

Hibiscus manihot Linnaeus, called *pelc* by the Tongans, is cultivated for its young growth, which is used as a green vegetable.

Family Bombacaceae

Genus **Ceiba** Medikus

Ceiba pentandra (Linnaeus) Gaertner, Fruct. et Semin. Pl. 2:244, pl. 183, fig. 1, 1791.

Medium to large, glabrous, soft-wooded tree with smooth or short-spiny bark and whorled, spreading branches. Leaves palmately compound, leaflets five to nine, elliptic to oblanceolate, entire, of various sizes, acuminate, petioles long. Flowers white or pinkish, petals pubescent, up to 2.5 cm. long; capsules up to 15 cm. long, seeds numerous, silky-hairy.

Introduced and now occasional in villages and along roadsides throughout the group.

The silky seed fibers are used as a filling for pillows and cushions. Probably of tropical American origin; now pantropic.

Tongan name: *tavae.*

Family Sterculiaceae

Genus **Melochia** Linnaeus

Melochia aristata A. Gray, U.S. Expl. Exped., Bot. 1:193, 1854.

Small tree, up to 4 m. or more tall. Leaves alternate, ovate, acute, base rounded, obtuse or abruptly acute, up to 12 cm. or more long and 8 cm. wide, palmately five- to seven-nerved, midrib branched upward, crenately toothed, petiole slender, up to 8 cm. or more

1 /Thespesia populnea -- Analyst/

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long. Flowers about 1 cm. wide, in compound, many-flowered, axillary cymes, corolla white in center, shading to rose outward; capsule ovoid, deeply five-lobed, carpels opening apically. All parts of the plant stellate-pubescent.

Tongatapu: *Forster.*

Vava'u: *Barclay; Harvey; Crosby;* in thicket near Ngofe swamp, May 19, 1953, *Yuncker 16029.*

Niuatoputapu: scrubby forest, mountain ridge above Vaipoa, alt. 100 m., Dec. 14, 1951, *Hürlimann 362;* coastal forest between Hihifo and Vaipoa, Dec. 14, 1951. *R. Hingano* (*Hürlimann 627*).

Infrequent. Also in Samoa.

M. odorata L. f. in Hemsley's and Burkill's lists.

Tongan names: *fukofuka, mako.*

The wood is light and is used for making floats for fish nets and also for firewood.

Genus **Waltheria** Linnaeus

Waltheria americana Linnaeus, Sp. Pl., 673, 1753.

Densely hairy, small, shrubby plant. Leaves alternate, oval-ovate, blunt or acutish, base rounded, cordulate, downy-pubescent, serrate, up to 8 cm. long, nerves prominent. Flowers small, in dense, axillary clusters, corolla yellow; capsules small, two-valved.

Vava'u: *Crosby.*

Infrequent. A tropical American weedy plant now of wide distribution in tropical countries.

Genus **Kleinhovia** Linnaeus

Kleinhovia hospita Linnaeus, Sp. Pl., ed. 2, 1365, 1763.

Tree, up to about 15 m. tall, young branches pubescent. Leaves alternate, broadly ovate, acuminate, base truncate or cordate, up to 15-20 cm. long and 15 cm. wide, entire, essentially glabrous, palmately five- to seven-nerved, midrib branched upward, petioles up to 8-10 cm. or more long. Flowers about 1 cm. long, in terminal or axillary panicles up to 30 or 40 cm. long, pedicels jointed at about middle, narrow sepals longer than pink or rose-colored petals, pubescent; capsules about 2 cm. long, membranous, inflated, obovate, five-parted, seeds usually one in each carpel, globose.

Vava'u: *Crosby;* edge of clearing along road about 3 miles northwest of Neiafu, May 20, 1953, *Yuncker 16083.*

Infrequent. From tropical Africa and India through Malaya to Polynesia.

Tongan name: *fukofuka.*

The wood is used for building purposes.

Genus **Sterculia** Linnaeus

Sterculia fanaiho Setchell, Carnegie Inst. Washington, Pub. 20: 69, fig. 13A, 1924.

Tree up to 8 m. or more tall. Leaves alternate, broadly elliptic-ovate, abruptly short-acuminate, base rounded, cordate, entire, up to 20 cm. or more long and 12 cm. wide, pal-

1 /Melochia aristata -- Analyst/

76: Yuncker N-4,5 (1953) 1959 OU9 Tonga OU9

[137] [824] [342] [313] [415] [278]

Tongan names: *feta'u, tamanu.*[1]

This strong and durable wood is used in house construction and other building purposes, and sections of the trunk are used to make large kava bowls. The oil from the seeds is used medicinally.

Calophyllum vitiense Turrill, Linn. Soc. Bot., Jour. 43: 17, 1915.

Tree, up to 10 m. or more tall, stems to 35 cm. in diameter. Leaves opposite, oblong-elliptic, obtuse or acute, base acute-decurrent, up to 13 cm. or more long and 5 cm. wide, leathery, glossy, entire, pinnately nerved, midrib prominent, lateral nerves very slender, numerous, parallel, petiole 1-2 cm. long, canaliculate. Flowers about 1.5 cm. wide, in racemose, axillary clusters, corolla pink, stamens numerous; fruit subglobose, 2 cm. or more in diameter, outer flesh pink when young.

'Eua: margin of forest near summit of eastern ridge, Mar. 24, 1953, *Yuncker 15435;* forest near center of island, Mar. 18, 1953, *Yuncker 15326.*

Kao: in forest on steep, rocky slope, May 6, 1953, *Yuncker 15883.*

Occasional. Also in Fiji and the Solomon Islands.

No differences of consequence are apparent among these specimens and the numerous Fijian collections referred to *C. vitiense,* except that the latter have white flowers. This species, not otherwise recorded from Tonga, is probably the one listed by Hemsley (Linn. Soc. Bot., Jour. 30: 169, 1894) as *C. spectabile* and by Burkill (op. cit. 35: 27, 1901) as *Calophyllum* sp. (A. C. Smith).

[824] [313]

Tongan name: *tamanu.*

The timber is strong and hard and is used for building purposes.

Genus Garcinia Linnaeus

Garcinia myrtifolia A. C. Smith, Jour. Arnold Arboretum 31: 315, 1950.

Glabrous tree, up to 7 m. or more tall, the trunk up to 25 cm. in diameter. Leaves elliptic or subovate, up to 14 cm. long and 7 cm. wide, obtuse or short-acute, base rounded, abruptly acute-decurrent, subcoriaceous, pinnately nerved, midrib prominent, lateral nerves numerous, very slender, petiole stout, canaliculate, about 1 cm. long. Flowers mostly solitary, on axillary pedicels about 1 cm. long; fruit ellipsoidal, about 2 cm. in diameter, with an apical crownlike thickening.

'Eua: edge of forest near center of island, Mar. 20, 1953, *Yuncker 15381.*

Kao: in forest on steep, rocky slope, May 6, 1953, *Yuncker 15908, 15955.*

Occasional.

These interesting specimens are clearly referable to the supposed Fijian endemic, of which at least three other Fijian collections have been noted since its description (A. C. Smith).

[824] [303]

Tongan name: *feto'omaka.*

The bark is used for scenting oil.

Garcinia pseudoguttifera Seemann, Fl. Vit., 40, 1865.

Tree, up to 6 m. or more tall. Leaves opposite, obovate, apex rounded, emarginate, base acute-decurrent, up to 7 cm. or more long and 5 cm. wide, coriaceous, pinnately

1 /Calophyllum inophyllum -- Analyst/

76: Yuncker N-4,5 (1953) 1959 OU9 Tonga OU9

'Eua: *Lister;* in forest near center of island, Mar. 19, 1953, *Yuncker 15351;* edge of forest, Fuai, near center of island, Mar. 19, 1953, *Yuncker 15362;* margin of forest near summit of eastern ridge, Mar. 24, 1953, *Yuncker 15436;* near shore near Ha'aluma, Apr. 1, 1953, *Yuncker 15589.* 137

Vava'u: *Crosby:* margin of forest above Feletoa village, May 19, 1953, *Yuncker 16021;* top of seaside cliff above Ha'alaufuli, May 21, 1953, *Yuncker 16087;* on seaward face of the limestone coastal cliff below Ha'alaufuli, May 21, 1953, *Yuncker 16095, 16102;* upper rim of seaside limestone cliff on the northwestern side of the island, May 25, 1953, *Yuncker 16177.*

Frequent throughout Tonga. Also in Fiji and southeastern Polynesia.

Tongan names: *filimoto, olamaka, kakala'uli.*

The timber is used in some house construction.

[824] [313] [342]

Genus **Flacourtia** L'Héritier

Flacourtia rukam Zollinger et Morren, Syst. Verz., 33, 1854.

Small or medium-sized tree up to 8 m. or more tall. Leaves simple, alternate, up to 15 cm. long and 8 cm. wide, elliptic-ovate, crenate, attenuately acuminate, base acute, on petioles scarcely 1 cm. long. Flowers small, greenish; fruit green, about 1 cm. long.

Niuatoputapu: secondary forest, base of range above Hihifo, alt. 40 m., Dec. 5, 1951, *Hürlimann 336.*

Infrequent. Dutch East Indies, Carolines, Niue, Samoa.

Genus **Homalium** Jacquin

Homalium vitiense Bentham, Linn. Soc. Bot., Jour. 4: 36, 1860.

Hemsley (Linn. Soc. Bot., Jour. 30: 178, 1895) lists a collection of this species made by Lister on 'Eua. It has been assumed that this species is a Fijian endemic. The species of the genus are difficult to separate and, not having the Lister collection for study, I have not been able to verify its identity.

Family PASSIFLORACEAE

Genus **Passiflora** Linnaeus

Passiflora edulis Sims, Curtis's Bot. Mag. 45: pl. 1989, 1818.

Glabrous, tendril-bearing vine. Leaves alternate, broadly ovate in outline, deeply palmately three-lobed, lobes serrate, sharply acute, sinus rounded, petioles mostly about 2 cm. long, with pair of conspicuous glands near base of blade. Flowers axillary, about 5 cm. wide, purplish white; fruit globose, about the size of a small egg, rind hard, pulp edible.

'Eua: trailing on ground in open area in Mua village, Apr. 7, 1953, *Yuncker 15666.*

A tropical American species widely disseminated in warm countries as an ornamental. It sometimes escapes and becomes established.

Tongan name: *vaine tonga.*

1 /Xylosma orbiculatum -- Analyst/

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Lifuka: in thicket near sea, north of Pangai village, Apr. 25, 1953, *Yuncker 15753;* on low cliff along eastern side of island, Apr. 21, 1953, *Yuncker 15771.* 137

Vava'u: *Crosby;* in seaside forest below Houma village, May 22, 1953, *Yuncker 16137.*

Tafahi: in forest between township of Tafahi and landing place, Tafe, Dec. 13, 1951, *Hürlimann 504.*

Frequent near shore throughout Tonga. A southern Asiatic species extending to the Philippines and Polynesia.

B. butonica Forst. in Hemsley's list and *B. speciosa* L. f. in Burkill's list.

Tongan name: *futu.*

The timber[1] is used for house construction, banana shooks, and so forth; the trunks, for dugout canoes; and the bark, as a fish poison. [824] [313] [342] [396] [226]

Family Rhizophoraceae

Genus **Rhizophora** Linnaeus

Rhizophora mangle Linnaeus, Sp. Pl., 443, 1753.

Round-topped, much-branched tree, sometimes up to 10 m. tall, bearing many, pendent, aerial roots which form an impenetrable entanglement. Leaves opposite, elliptic or obovate-elliptic, apex blunt and often slightly notched, base acute and decurrent on petiole, up to 10-12 cm. long and 6-7 cm. wide, somewhat leathery, pinnately nerved, midrib stout, lateral nerves slender. Flowers few, four-parted, about 2 cm. wide, yellow, in simple, axillary, cymose clusters, seed usually germinating while on tree, producing a radicle up to 30 cm. long.

Tongatapu: forming a grove on the tidal flat at Sopu, west of Nuku'alofa, Feb. 25, 1953, *Yuncker 15023;* May 30, 1953, *Yuncker 16206.*

Nomuka: along shore of large central lake, Apr. 30, 1953, *Yuncker 15847.*

Vava'u: along shore below Houma village, May 22, 1953, *Yuncker 16130;* along shore of lagoon, Vaihoi, near Leimatua village, May 26, 1953, *Yuncker 16185.*

Occasional throughout Tonga. Tropical America and westward to Fiji, Samoa, and Tonga, where it seems to meet but remain distinct from the following species.

Tongan name: *tongolei.*

The timber is durable and used in a variety of ways; the roots are used in house construction; the sap, for dyeing. [824] [313] [342] [386]

Rhizophora mucronata Lamarck, Encycl. Méth. 6: 189, 1804.

This species closely resembles the preceding, differing chiefly in having sharply pointed leaves.

Vava'u: *Harvey; Crosby.*

Infrequent. A species of the Old World tropics extending into Polynesia.

1 /Barringtonia asiatica -- Analyst/

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Genus **Bruguiera** Lamarck

137 **Bruguiera conjugata** (Linnaeus) Merrill, Philippine Jour. Sci. 9C: 118, 1914.

Small tree similar in habit to *Rhizophora*, up to 4 m. or more tall. Leaves alternate, elliptic, acuminate, base decurrent along petiole, up to 12 cm. or more long and 4-5 cm. wide, coriaceous, somewhat glossy, finely pinnately nerved, petiole up to 4 cm. or more long. Flowers greenish yellow, solitary, axillary, about 3 cm. long, calyx lobes very narrowly lanceolate, acute, usually 10, up to 1.5 cm. long; fruit included in calyx tube, seed germinating on tree and forming an elongated radicle.

Nomuka: along shore of central lake, Apr. 30, 1953, *Yuncker 15828*.

Vava'u: *Crosby*.

Occasional near shore but less frequent than *Rhizophora*. From tropical Asia through Malaya to Polynesia.

B. rheedii Blume in Hemsley's list and *B. gymnorhiza* Lam. in Burkill's list.

Tongan names: *tongo, tongo ta'ane*.

[824] [313] [386] The hard and durable wood is used in many ways, and an extract of the flowers furnishes a dye.

Family COMBRETACEAE

Genus **Terminalia** Linnaeus

Terminalia catappa Linnaeus, Mantissa 1: 128, 1767.

Medium to large tree with whorled, horizontal branches. Leaves clustered toward ends of branches, obovate, obtuse or abruptly acute, base narrowing, narrowly and abruptly obtuse at petiole, entire, up to 25 cm. or more long and 15 cm. wide, pinnately nerved, petioles short and stout. Flowers small, greenish white, in axillary, spikelike clusters near ends of branches; fruit oval, flattened, two-edged, greenish to red, up to about 5 cm. long, flesh thin and edible.

Tongatapu: *U.S. Expl. Exped.*; in open forest near Nualei, Mar. 9, 1953, *Yuncker 15246*; in seaside thicket below Ha'akame village, Mar. 12, 1953, *Yuncker 15286*.

'Eua: in seaward forest on terrace above Houma village, Mar. 26, 1953, *Yuncker 15506*.

Lifuka: roadside near north end of island, Apr. 25, 1953, *Yuncker 15752*.

Tafahi: shore, northeast coast north of Fakafafa moe Tauloto, Dec. 17, 1951, *Hürlimann 601*.

Niuatoputapu: forest on plain southeast of Falehau, alt. 5 m., Dec. 7, 1951, *Hürlimann 385*.

Frequent throughout Tonga, commonly near the shore. From tropical Asia eastward to Polynesia; naturalized in America.

Tongan name: *telie*.

[824] [313] [396] [278] [262] The timber is used for construction purposes, canoes, banana shooks, and so forth; the leaves, for medicine; and the fruit, as food.

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Terminalia litoralis [*fide* Index Kewensis] Seemann, Fl. Vit., 94, 1865. 137

Small tree, up to 6 m. or more tall. Leaves clustered near ends of branches, obovate, apex rounded to slightly emarginate, base narrowly obtuse, entire, pinnately nerved, up to 15-18 cm. long and 10-12 cm. wide. Flowers white, small, in narrow, elongated, racemose, axillary clusters; fruit ellipsoidal, up to 2.5 cm. long, somewhat angled but scarcely ridged.

Terminalia litoralis var. **litoralis.**

Branches, leaves, and inflorescence parts glabrous.

Tongatapu: in strand forest below the village of Fu'amotu, Mar. 4, 1953, *Yuncker 15171.*

Nomuka: in thicket near the central lake, along the road encircling the island between the sea and the central lake, Apr. 30, 1953, *Yuncker 15852.*

Terminalia litoralis var. **tomentella** Hemsley, Linn. Soc. Bot., Jour. 30: 177, 1895, *nomen nudum.*—Burkill, Linn. Soc. Bot., Jour. 36: 37, 1901.

Young branches, petioles, peduncles, pedicels, and lower leaf surface tomentulose.

Tongatapu: in thicket near shore, Sopu, west of Nuku'alofa, Feb. 25, 1953, *Yuncker 15017, 15021,* May 30, 1953, *Yuncker 15300.*

'Eua: *Lister;* seaward margin of forest on terrace above Houma village, Mar. 26, 1953, *Yuncker 15494.*

Lifuka: *Harvey.*

Vava'u: *Harvey.*

On the basis of the material collected and observed in the field, variety *tomentella* is more common than variety *litoralis.* The species is variable and the status of variety *tomentella* is somewhat questionable. It is frequent in seaside thickets throughout the group. This species also occurs in Fiji and other parts of Polynesia.

Tongan name: *telie'amanu.*

The wood is used to some extent in house construction.

[824
342
313]

Genus **Lumnitzera** Willdenow

Lumnitzera littorea (Jack) Voigt, Hort. Suburb. Calcut., 39, 1845.

Small, glabrous tree, up to 5 m. or more tall. Leaves alternate, crowded toward the ends of the branches, spatulate, the apex rounded, emarginate, the base cuneate, entire, up to about 8 cm. long, faintly pinnately nerved, subsessile on very short petioles. Flowers about 1 cm. or less wide and 1-2 cm. long, subsessile, in terminal or subterminal, loose, spikelike clusters, the calyx green, the corolla bright red; the fruit ellipsoidal, crowned with the calyx, 2 cm. or more long.

Tongatapu: *U.S. Expl. Exped.;* in seaside thicket, Sopu, west of Nuku-'alofa, Feb. 25, 1953, *Yuncker 15020,* May 30, 1953, *Yuncker 16208.*

'Eua: *Lister.*

Locally distributed in Tonga. Along the coasts from tropical Asia to Australia and Polynesia.

Tongan name: *hangale.*

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137 Also in Fiji. For a discussion of this species see Lily M. Perry (Jour. 113 Arnold Arboretum 31: 363-364, 1950).

Syzygium clusiaefolium (A. Gray) C. Mueller, Walpers Ann. Bot. Syst. 4: 839. 1857.

Tree, up to 8 m. or more tall. Leaves opposite, oval or oval-obovate, apex rounded, obtuse to short-acute, base acute to cuneate, up to 15 cm. long and 8 cm. wide, coriaceous, entire, pinnately nerved, lateral nerves numerous, very slender, joining with a submarginal nerve, petiole about 1 cm. long, canaliculate. Flowers small, numerous, in large, open, paniculate clusters, borne on trunk and larger branches; fruit ovoid, up to 1 cm. or more in diameter, dark purple, edible.

Tongatapu: swampy area between village of Navutoka and sea, Feb. 27, 1953, *Yuncker 15085.*

'Eua: in open forest near center of island, Mar. 19, 1953, *Yuncker 15386.*

Kao: in forest on rocky slope, May 6, 1953, *Yuncker 15907.*

Vava'u: *Crosby;* near upper rim of seaside cliff above Ha'alaufuli, May 21, 1953, *Yuncker 16108.*

Niuafo'ou: inner slope of main crater, facing large central lake, May 16, 1953, *Yuncker 16005.*

Rather frequent throughout the group. Also in Niue and Samoa.

Eugenia clusiaefolia A. Gr. in Hemsley's list, *fide* Burkill.

Syzygium corynocarpum (A. Gray) C. Mueller, Walpers, Ann. Bot. Syst. 4: 839. 1857.

Shrub or small tree, up to 7 m. or more tall. Leaves opposite, elliptic or oblong-elliptic, bluntly acuminate, base acute, up to 14 or 15 cm. long and 5 cm. wide but mostly smaller, pinnately nerved, lateral nerves slender and submarginally loop-connected, paler on lower surface, petioles 5 mm. long, canaliculate. Flowers sessile or subsessile; fruit elongated, beaked.

Tongatapu: *Home;* in open forested area near village of Niutoua, Mar. 2, 1953, *Yuncker 15166.*

'Eua: in open forest along trail between Pangai village and Fuai, Mar. 25, 1953, *Yuncker 15469.*

Nomuka: in clearing near road encircling island, Apr. 30, 1953, *Yuncker 15833.*

Vava'u: *Crosby.*

Occasional throughout Tonga. Also in Fiji and Samoa.

Tongan name: *hehea.*

824 313 262 301 278 The timber is used for construction purposes; the fruit is eaten and used for leis; and the leaves and bark are used in medicines.

Syzygium cumini (Linnaeus) Skeels, U.S. Dept. Agric., Bur. Pl. Ind., Bull. 248: 25, 1912.

Shrub or medium to large tree. Leaves opposite, oblong to oval, obtuse or acute, 8-14 cm. long and 3-6 cm. wide, rather thick and shining, pinnately nerved. Flowers

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137 shallowly canaliculate. Flowers large, red, on pedicels 1 cm. or less long, in lateral or terminal, racemose clusters: fruit obovoid, 7 cm. or more in diameter, fleshy, red, one-seeded, edible.

Tongatapu: *U.S. Expl. Exped.;* in open woods near village of Lavengatonga, Mar. 6, 1953, *Yuncker 15178;* in open woods near sea below village of Fatai, Mar. 10, 1953, *Yuncker 15265.*

'Eua: in open forest on sea-facing terrace along trail descending to Lokupo, Mar. 27, 1953, *Yuncker 15529.*

Nomuka: in clearing along road encircling island, Apr. 30, 1953, *Yuncker 15858.*

Lifuka: on limestone cliff along eastern side of island near middle, Apr. 27, 1953, *Yuncker 15772;* margin of plantation near north end of island, May 6, 1953, *Yuncker 15988.*

Vava'u: *Crosby.*

Frequent throughout Tonga. A native of Indo-Malaya, now widely grown in warm countries.

Tongan name: *fekika kai.*

[824] [313] [262] [278] The timber is used for construction work: the fruit, as food; and the bark and leaves, in medicines.

Syzygium neurocalyx (A. Gray) Christophersen, B. P. Bishop Mus., Bull. 154: 27, 1938.

Shrub or small tree, up to about 4 m. tall. Leaves opposite, oval-oblong or subovate, obtuse, base rounded, truncate or cordulate, up to 18 cm. long and 8 cm. wide, pinnately nerved, lateral nerves submarginally loop-connected, paler beneath, petioles scarcely 5 mm. long, stout. Flowers large, sessile, solitary or in terminal and axillary, headlike clusters, calyx tube ribbed.

Tongatapu: in open forest below Nualei, Mar. 9, 1953, *Yuncker 15247.* This specimen is sterile and only tentatively referred to this species with which it agrees well in its vegetative characters.

Infrequent. Also in Fiji and Samoa.

Tongan name: *koli.*

[824] [301] The fruit is used in leis.

Syzygium richii (A. Gray) Merrill and Perry, Sargentia 1: 77, 1942.

Medium to large tree, up to 8 m. or more tall. Leaves opposite, oval or oval-subobovate, abruptly pointed, base rounded, cordulate, up to 25 cm. or more long and 14 cm. wide, coriaceous, pinnately nerved, lateral nerves submarginally loop-connected. Flowers large, in large, branching, axillary clusters, petals four, white, early deciduous, stamens many, long, yellow; fruit ovoid, red.

Tongatapu: in forest near the sea below the village of Niutoua, Mar. 2, 1953, *Yuncker 15140;* in seaside thicket, Blow Hole area near Houma village, June 5, 1953, *Yuncker 16246.*

1 /Syzygium malaccense -- Analyst/

76: Yuncker N-4,5 (1953) 1959 OU9 Tonga OU9

Nomuka: near sea along road encircling island, Apr. 30, 1953, *Yuncker 15813.* 137

Vava'u: *Harvey.*

Frequent near the shore throughout Tonga. Also in Fiji.

Tongan name: *heavula.*

The timber is used for handicraft work.

[824]
[313]

Genus **Metrosideros** Banks

Metrosideros collina (J. R. and G. Forster) A. Gray, U.S. Expl. Exped., Bot. 1: 558, fig. 68, 1854.

Shrub or small tree, up to 15 m. or more tall. Leaves opposite, variable in shape, elliptic, ovate, or suborbicular, obtuse or acute, base rounded, acute, or cordate, about 6 cm. long and 3 cm. wide, or sometimes up to 10 cm. long, pinnately nerved, midrib strong, lateral nerves slender and submarginally united, petiole about 5 mm. long. Flowers subsessile or sessile, in terminal and axillary, cymose clusters of three to five flowers, red or yellow.

Tongatapu: *Beechey.*

Vava'u: *Harvey.*

Infrequent. Throughout Polynesia.

M. polymorpha Gaudichaud in Hemsley's list.

Genus **Eucalyptus** L'Héritier

Eucalyptus spp.

Occasional specimens of introduced, unidentified species of *Eucalyptus* were noted on Tongatapu.

Family Melastomaceae

Genus **Melastoma** Burmann

Melastoma denticulatum Labillardière, Sertum Austro-Caledonicum 1: 65, pl. 64, 1824.

Branched, spreading shrub, up to 2 m. tall. Leaves simple, opposite, ovate or ovate-lanceolate, acuminate, base rounded, obtuse or acute, up to 10 cm. long and 3 cm. wide, palmately five-nerved, the three inner nerves prominent, leaves and twigs covered with stiff, flat, setose, appressed hairs, petiole up to about 1 cm. long. Flowers pinkish white, 1-2 cm. wide, clustered at ends of branches, calyx densely covered with appressed, scabrous hairs.

'Eua: *Lister;* on sides of old sinkhole along trail near center of island, Mar. 20, 1953, *Yuncker 15373.*

Kao: at margin of upper forest limit, about 480 m. alt., May 6, 1953, *Yuncker 15905.*

Occasional on the higher islands. Also in New Caledonia, Fiji, and Society Islands.

Tongan name: *pesikuku.*

1 /Syzygium richii -- Analyst/

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Niuatoputapu: range above Hihifo, alt. 100 m., Dec. 12, 1951, *Hürlimann 345;* forest, coastal flat south of Falehau, Dec. 28, 1951, *Hürlimann 642.* 137

Southeastern Asia, Malaysia, New Caledonia to Samoa.

Maba elliptica Forst. in Hemsley's and Burkill's lists.

Diospyros ferrea (Willdenow) Bakhuizen, Gard. Bull. Straits Settlem. 7: 162, 1932.

Tree up to 6 m. or more tall. Leaves alternate, coriaceous, glossy, somewhat hairy or glabrate, elliptic, ovate, or elliptic-subobovate, the apex rounded or slightly pointed, base acute or obtusish, up to 8 cm. long and 4 cm. wide, petiole scarcely 5 mm. long. Flowers small, greenish yellow, three-parted, hairy, in small, axillary, branching clusters; fruit orange, red, or purple, elliptical or globose, up to 1 cm. or more in diameter, edible.

Tongatapu: in forested area between Niutoua village and the sea, Mar. 2, 1953, *Yuncker 15124.*

'Eua: *Lister;* in seaward margin of forest above Houma village, Mar. 26, 1953, *Yuncker 15493.*

Nomuka: in thicket near shore of central lake, Apr. 30, 1953, *Yuncker 15842.*

Lifuka: in thicket near sea, north of Pangai village, Apr. 25, 1953, *Yuncker 15735.*

Vava'u: in thicket near sea below Houma village, May 22, 1953, *Yuncker 16131;* at summit of Talau, west of Neiafu, May 23, 1953, *Yuncker 16144.*

Frequent throughout Tonga. India and Ceylon eastward to the Hawaiian Islands.

Maba buxifolia (Rottb.) Pers. in Hemsley's list.

Tongan name: *kanume.*

The wood is used in handicraft work and the bark in preparing medicines. [824] [313] [278]

Diospyros lateriflora (Hiern) Bakhuizen, Jard. Bot. Buitenzorg, Bull. III, 15: 8, in key, 1936.

Tree, up to 7 m. or more tall. Leaves alternate, entire, elliptic-ovate, coriaceous, glossy, up to 16 cm. or more long and 9 cm. wide, apex rounded or bluntly acute, base acute, pinnately nerved, petiole scarcely 1 cm. long. Flowers small, hairy, in small, compact, axillary clusters; fruit elliptical, pubescent, up to 4 cm. long.

Tongatapu: in open forest below Nualei village, Mar. 9, 1953, *Yuncker 15236.*

'Eua: in open forest about center of island, Mar. 19, 1953, *Yuncker 15355.*

Lifuka: in seaside thicket near southern end of island, Apr. 28, 1953, *Yuncker 15777.*

Vava'u: *Crosby.*

Occasional throughout Tonga; also in Fiji.

Maba lateriflora Hiern of Burkill's list.

Tongan name: *mapa.*

The fruit is used in leis.

[824] [301]

76: Yuncker N-4,5 (1953) 1959)U9 Tonga 0U9

137 **Diospyros samoensis** A. Gray, Am. Acad. Arts Sci., Proc. 5: 326, 1862.

Tree, up to 10 m. or more tall. Leaves alternate, coriaceous, glossy, entire, elliptic-ovate, acute at both ends, up to 15 cm. or more long and 6 cm. wide, pinnately nerved, glabrous, petiole scarcely 1 cm. long. Flowers solitary or in small axillary clusters, corolla fleshy, cream color; fruit subglobose, 1 cm. or more in diameter.

'Eua: seaward margin of forest on terrace above village of Houma, Mar. 26, 1953, *Yuncker 15495, 15496;* in forest on seaward terrace along trail descending to Lokupo, Mar. 27, 1953, *Yuncker 15521.*

Kao: in open forest on steep rocky slope, May 6, 1953, *Yuncker 15967.*

Vava'u: in open forest on slope leading to lagoon below Leimatua, May 26, 1953. *Yuncker 16191.*

Niuafo'ou: inner margin of big crater mouth between Futu and great lake, alt. 60 m., Jan. 7, 1952. *Hürlimann 661.*

Tafahi: forest below top of Piu 'o Tafahi, alt. 590 m., Dec. 12, 1951, *Hürlimann 461.*

Niuatoputapu: forest, range above Vaipoa, alt. 105 m., Dec. 5, 1951, *Hürlimann 352, 361.*

Occasional on the higher islands. Also in Fiji and Samoa.

Tongan names: *tutuna, kakala'uli, kolivao.*

[824] [313] The timber is considered excellent as firewood.

Family Oleaceae

Genus **Linociera** Swartz

Linociera sp.

Tree, up to about 8 m. tall. Leaves opposite or essentially so, elliptic-oblong, attenuate, base cuneate, up to about 15 cm. long and 6 cm. wide, glabrous, entire, pinnately nerved with prominent midrib, petioles up to about 1.5 cm. long. Flowers small, white, four-parted, very fragrant, in small, axillary and terminal, lilac-like clusters.

Vava'u: *Crosby.*

Tafahi: Tafahi to landing place, Tafe, alt. 5 m., Dec. 13, 1951, *Hürlimann 509.*

Infrequent. Also in Niue.

L. pauciflora C. B. Clarke in Burkill's list. It appears unlikely that the plants of Tonga and Niue can represent this species, the type of which was from Penang and which probably does not extend into the Pacific area. The Tongan specimens need further study to determine their status. For a discussion of this question see A. C. Smith (Torrey Bot. Club, Bull 70: 548-549, 1943).

Genus **Jasminum** Linnaeus

Jasminum didymum Forster f., Fl. Ins. Australia, Prodr., 3, 1786.

High-climbing woody vine. Leaves opposite, three-parted, leaflets ovate, acute, base acute or obtusish, terminal leaflet up to 7 cm. or more long and 5 cm. wide, lateral leaflets

76: Yuncker N-4,5 (1953) 1959 OU9 Tonga OU9

Tongatapu: *Nelson;* near Niutoua village, Mar 2, 1953, *Yuncker 15141.* 137
'Eua: in forest on seaward side of cliff above Houma village, Mar. 26, 1953, *Yuncker 15509.*

Kao: lower margin of forest near an old plantation, May 6, 1953, *Yuncker 15969.*

Vava'u: *Crosby.*

Occasional throughout Tonga at low altitudes. Philippines, Micronesia, and New Caledonia east to the Societies and Marquesas.

O. parviflora (Forst.) Hemsl. in Hemsley's and Burkill's lists.

Tongan name: *fao.*

The wood is used for construction work and the leaves to wrap fish for baking. The seeds are edible. [824] [313] [252] [262]

Genus **Bleekeria** Hasskarl

Bleekeria vitiensis (Markgraf) A. C. Smith, Torrey Bot. Club, Bull. 70: 549, 1943.

Tree up to 7 m. or more tall, latex white. Leaves whorled, elliptic-oblanceolate, acute, base cuneate-decurrent, up to 12 cm. or more long and 3 cm. wide, pinnately nerved, lateral nerves very slender, somewhat coriaceous, petiole about 1 cm. long, ridged by decurrent blade margins. Flowers white, in axillary cymose clusters; fruit compressed-elliptic, in pairs, about 4 cm. long and 2 cm. wide.

Vava'u on upper rim of seaside cliff above Ha'alaufuli on northeastern side of island, alt. about 120 m., May 21, 1953, *Yuncker 16107.*

Tongan name: *toto hina.*

The cited specimen, with both flowers and fruits, does not differ essentially from the specimens listed by Markgraf as *Excavatia vitiensis* (B. P. Bishop Mus., Bull. 141: 127, fig. 66, *b, c,* 1936) from the Lau Islands of Fiji. A probable record of this species in Tonga was noted by Burkill (Linn. Soc. Bot., Jour. 35: 46, 1901) as *Ochrosia elliptica* Labill., a species properly known as *Bleekeria elliptica* (Labill.) Koidz. and perhaps occurring no farther east than the larger islands of Fiji. (A. C. Smith.) [113] [113]

Genus **Cerbera** Linnaeus

Cerbera manghas Linnaeus, Sp. Pl., 208, 1753.

Small tree, up to 7 m. or more tall. Leaves simple, entire, glossy, spirally and closely arranged, lanceolate or obovate-lanceolate, acuminate, base acute-decurrent, up to 20-30 cm. long and 5-8 cm. wide, petiole 2-3 cm. long, narrowly winged by decurrent blade margins. Flowers in long-pedunculate, branching, terminal clusters, corolla salverform, white with yellow throat, 3 cm. or more wide, aromatic; fruit oval or elliptical, large, smooth, black when ripe.

Tongatapu: *Moseley;* in thicket along strand below Navutoka village, Feb. 27, 1953, *Yuncker 15106.*

1 /Ochrosia oppositifolia -- Analyst/
^

76: Yuncker N-4,5 (1953) 1959 OU9 Tonga OU9

'Eua: *Lister.*

Lifuka: in seaside thicket north of Pangai village, Apr. 25, 1953, *Yuncker 15747;* in seaside thicket near southern end of island, Apr. 28, 1953, *Yuncker 15790.* 137

Kao: on lower rocky slope in clearing, May 6, 1953, *Yuncker 15878.*

Vava'u: *Crosby; Harvey.*

Niuafo'ou: near shore of central crater lake, May 16, 1953, *Yuncker 16011.*

Common near the shore throughout Tonga. An Indo-Malaysian strand species extending into Polynesia.

Tongan name: *puopua.*

The wood is used for general construction work, banana shooks, and so forth; the bark, in preparing medicines; and the flowers, to perfume oils. [824] [313] [278] [303]

Genus **Timonius** de Candolle

Timonius polygamus (Forster f.) Robinson, Am. Acad. Arts Sci., Proc. 45: 394, 1910.

Shrub, about 2 m. or more tall. Leaves opposite, obovate, apex rounded, obtuse or slightly pointed, base acute or obtusish, rather thick, glossy above, up to 10 cm. or more long and 5 cm. wide, pinnately nerved, petiole scarcely 5 mm. long. Flowers white, pubescent, solitary or several in cymose clusters on rather long, axillary peduncles; fruit subglobose, about 1 cm. long, crowned with calyx.

Vava'u: *Crosby;* along upper edge of limestone coastal cliff above Leimatua, May 25, 1953, *Yuncker 16075.*

Occasional. Eastern Fiji to the Tuamotus and Henderson Island.

T. forsteri DC. in Burkill's list.

Genus **Coffea** Linnaeus

Coffea arabica Linnaeus, Sp. Pl., 172, 1753.

Shrub or small tree, about 2-3 m. tall. Leaves opposite, oblong-elliptic to subobovate, glossy, acuminate, base acute, glabrous, pinnately nerved, petiole about 1 cm. long. Flowers white, fragrant, short-pedicellate, in axillary clusters; fruit ovoid, red, two-seeded.

Tongatapu: in plantation below Nualei village, Mar. 9, 1953, *Yuncker 15226.*

Occasional in villages or plantations. A tropical African species now widely grown in tropical countries.

Tongan name: *kofi.*

Genus **Ixora** Linnaeus

Ixora calcicola A. C. Smith, sp. nov. (fig. 13).

Frutex ad 1.5 m. altus, ramulis glabris teretibus rugulosis cinereis apices versus circiter 2 mm. diametro; stipulis libreis glabris circiter 4 mm. longis e basi late ovato in aristam rigidam ad 2 mm. longam angustatis, pilis supra cicatricibus castaneis circiter 1 mm. longis; foliis glabris, petiolis semiteretibus rugulosis 3-6 mm. longis, laminis papyraceis

1 /Guettarda speciosa -- An lyst/

87: Wood M,Y-4,5 (no date) 1932 OU9 Tonga OU9

than the way in which they noose sharks; instances of sharks attacking natives are very rare. Whales are sometimes caught. Turtles are also plentiful. Perhaps the most interesting creature in Tonga is a land-tortoise, now kept in the Palace grounds at Nuku'alofa, and reputed to have been left by Captain Cook; it has been scarred by bush-fires and other accidents, but in its old age it is honoured as though it were a chief and is called Tu'imalila, after a part of Labaha called Malila.

The graceful coconut-palm is the most distinctive as well as the most valuable of plants in Tonga. All parts of the islands being very close to the sea, coconut trees thrive everywhere, and copra, the dried kernel of the nut, is the staple product. Other plants which grow in profusion are many varieties of banana, plantain, yam, sweet potato, talo, manioc, sugar-cane, pineapple, breadfruit, papaw-apple, mango and arrowroot. Coffee, cocoa and cotton have been introduced but are not yet extensively grown. Various European vegetables have also been introduced, and corn has proved the best cereal for this climate.

Bananas, sweet potatoes, pineapples, tomatoes, pumpkins and oranges could be exported in abundance, if markets were available. The staple foodstuffs of the people are yam, sweet potato, talo, manioc, kabe, plantain, breadfruit, etc.

The bark of the paper-bark mulberry is extensively used for making native cloth (taba and gatu), and the sap of the koka tree is used for stamping this cloth. Mats are made from the leaves of the pandanus, but unfortunately this domestic manufacture is declining generally, except in Ha'abai. The trunks of the toa (ironwood) and koka are used for the posts of native buildings, but timber generally suitable for building European houses is not found in Tonga. The ironwood or casuarina tree was used for making clubs and spears formerly, and is still used for spade handles and mallets. The best of the old canoes were brought from Fiji, where more suitable timber for all purposes is available.

Kava, the juice of a species of pepper-plant, is the national drink on all occasions. Other interesting trees are the ovava, a species of banyan; gatae and tuitui (candle-nut) used for marking boundaries; Malayan apple or fekika, tava, and the ifi, whose leaves were hung round the neck in token of surrender or penitence in olden times.

Government statistics in 1931 show a total of 2,658,644 coconut trees and 832,655 banana plants in the Kingdom, 94% being owned by Tongan cultivators.

EXPORTS.

Tonga is entirely an agricultural country, being without minerals and secondary industries. It is unfortunate that there are still fairly considerable areas of undeveloped land even in such a small country, especially in Togatabu and 'Eua, and further that several hundred taxpayers have no allotments; this latter condition is mainly due to indolence on the part of some who live in the chief towns, but in the case of the overcrowded islands of Ha'abai it rises from rather a natural reluctance to leave an old home. The Government is now making strenuous efforts to enforce both more systematic cultivation of coconut-growing land and

137 guajava and Paspalum conjugatum have become naturalized and
311 constitute dominant species. The areas in which this association occurs have no agricultural potential, unless
[228] reclaimed. Such lands are presently being developed as fish ponds.

137 Mangrove Swamp
311

Zones of mangrove swamp are found along the sheltered margins of the north coast, extending from Kolovai in the west to Navutoka in the east, and including areas surrounding Nuku'alofa and the interior lagoon. This association
137 consists of trees actually growing in salt or brackish
[133] water on a muddy substratum below the limits of high tide. Although it merges on its inner margins with representatives of the swamp forest association, the mangrove swamp is generally lower and more gregarious, composed largely of only Rhizophora mangle, Rhizophora mucronata, and Bruguiera conjugata. These areas have little or no agri-
311 cultural potential unless reclaimed, although valuable dyes,
● 313 timber, and firewood are obtained from the mangrove species. A number of bush allotments have sections of mangrove swamp and, with the shortage of timber trees, these swamps have become the major source of firewood on the island.

137 Tropical Lowland Forest
311

Presumably the entire well-drained central upland was originally covered with dense tropical lowland forest. Today, however, there are only remnants of primary forest.

137 simplicifolium, Alyxia stellata and Dryopteris invisa. Lianas and epiphytes include Entada phaseoloides and Asplenium nidus. A fungus, Auricularia polytricha, is also found growing on dead logs during rainy spells. In the more open and cutover sites, the exotics Lantana camara and Psidium guajava plus Passiflora maliformis, Dioscorea bulbifera, Digitaria pruriens, and Paspalum conjugatum are among the dominant understory species and often form dense thickets.

311 Regardless of the species composition, these remaining stands of tropical lowland forest represent probably the best potential agricultural land on Tongatapu with [241] respect to soil fertility. These areas have either never been cultivated or have been under fallow for sufficient time to allow for considerable replenishment of organic [313] material and plant nutrients. Furthermore, these stands are valuable sources of timber, firewood, and traditional [439] medicines. The dried fungus is exported to Hong Kong.

Plant Species Important in Cropland and Secondary Vegetation

311 The cropland and secondary vegetation, which comprise
241 over 90 percent of the total land area of Tongatapu, are
137 characterized by a succession of gardens and fallow areas
128 in various stages of regrowth. A detailed description of
241 this vegetation , which is comprised largely of introduced
137 species, constitutes much of the core of this dissertation.

245 banana plantations. Nevertheless, the banana industry
[439] continues to be a major source of cash income to the Tongan farmer, and the 8 1/4 acre bush allotments continue to be the major suppliers of bananas to the Produce Board for shipment to New Zealand.

313 One important effect of the increase in banana production in the 1960's was the need for locally produced banana cases which put considerable pressure on the timber resources of Tongatapu as well as 'Eua and Vava'u. In fact, by 1968, the timber resources on Tongatapu had been reduced to such an extent that milling ceased and was shifted to 'Eua (Government of Tonga, 1969a:16).

241 There has been a continuing attempt by the Tonga
439 Produce Board and the Tongan Government to diversify export
655 crops and broaden Tonga's agricultural base. In the case of watermelons, pineapples, plantains, tomatoes, and bell peppers, which are exported through the Produce Board, the
241 results have been quite encouraging. Some crops are also
439 presently being shipped through independent marketing
[441] agencies to New Zealand, Fiji, Samoa, and the United States. These include mangoes, tomatoes, bell peppers, egg plant, green beans, ginger, yams, taro, and sugar cane. The export values for these products for the five year period from
[441] 1967 to 1971 are included in Table 23.A Most of these independent exporters are individuals or church or missionary societies, holding leasehold rights to large tracts of land

A [See Category 439, pp. 152-155--Analyst.]

231 mares to upgrade the standard of work horses in the Kingdom.
232
654 Owing to the rapid elimination of native forest species
654 on Tongatapu, as a result of the need for firewood and
245 timber for banana shooks and other purposes, the Agriculture
318 Department has a limited reforestation program, which
[313] includes nurseries at Sopu on Tongatapu and on 'Eua and the issuance of seedlings to interested allotment holders. The major species which have been planted by individual allotment holders have been Casuarina equisitefolia, Eucalyptus spp., and Grevillea robusta, all natives of Australia, and the tropical American Cedrela odorata. The only major reforestation project in the Kingdom has been conducted on 'Eua, where 200 acres of Pinus caribaea have been successfully established (Government of Tonga, 1971c:26). On Tongatapu, there are only limited cases where farmers have planted introduced forest species on their allotments.

241 In conclusion, the overall effect of the recent
231 introductions of new techniques and plant and animal
179 material on the Tongan agricultural system seems to have
241 been minimal. This is in spite of considerable subsidies
231 offered by government agencies and a recently expanded
654 agricultural extension program, yearly agriculture shows,
207 a system of "Rural Broadcasting" designed to improve agri-
179 cultural education over the radio, the establishment of a Government Agricultural Training Center at the Experimental Farm in Vaini, and a continued overall effort by the Agri-

241
245
[654]

Only 56 of the 101 sample allotments had recently planted coconuts. The median coverage for these allotments was only 25 percent. Because of senility and declining productivity of most palms on Tongatapu, the Coconut Replanting Scheme has subsidized the planting of new palms. Although a majority of allotments had some replanted palms, in very few instances were they well maintained. Nevertheless, there seemed to be sufficient replanting to insure the coconut palm's future as the dominant tree and most valuable plant on the bush allotments.

Fruit Trees

In addition to coconut palms, there were 25 species of fruit trees among the plant associations on the 101 [125] sample bush allotments (Table 38). For most species, numbers of individuals were tabulated, but individual Citrus species were difficult to differentiate and only presence or absence was noted.

The most common trees were mango (Mangifera indica), citrus trees (Citrus spp.), tava (Pometia pinnata), breadfruit or mei (Artocarpus altilis) and Tahitian chestnut or ifi (Inocarpus edulis), all of which were present on over 50 percent of the sample bush allotments. In most cases, these trees are protected and preserved during the clearing [313] of secondary vegetation for cultivation. However, there is a growing tendency to utilize many of these important tree crops for firewood and timber.

241 (Syzygium aromaticum), huni (Phaleria disperma), fehi
245 (Bauhinia monandra), and sita (Melia azedarach). Jatropha curcas is commonly planted as a living fence and, on one sample allotment, to support vanilla. The other species are generally planted as borders near dwellings or around
137 small family cemeteries. Phaleria disperma is also found wild in coastal littoral forest, while M. azedarach is sometimes found as an escape.

241 Three tree species that have been introduced by the
245 Department of Agriculture as part of a reforestation pro-
654 gram were also found on some of the sample allotments:
318 silky oak or 'oke (Grevillea robusta) on eight allotments; Australian gum or pulukamu (Eucalyptus spp.) on two allotments; and cigar box cedar or sita Palangi (Cedrela odorata)
241 on one allotment. Extensive stands of G. robusta and C.
245 odorata approximately seven years in age had been planted on one allotment.

241 On the sample bush allotments there seems to be a
137 lower concentration of useful trees in west central Hahake, between Vaini and Fua'amotu and in north central Hahake, southwest of Kolonga, presumably because of the high incidence of plowing and frequent wildfire.

241 Although there is still a considerable diversity of
137 valuable trees found throughout the cultivable area as well as in portions of coastal, swamp, and mangrove forests on
313 Tongatapu bush allotments, the current shortage of timber

241 and firewood, together with the increasing use of the plow,
137 will undoubtedly bring about a further reduction of these
313 species. Trees such as nukonuka (Decaspermum fruticosum),
137 tangato (Pleiogynium solanderi), and hea (Parinarium insularum) which, according to Tongan informants, were common throughout Tongatapu in the past, were not encountered in the sample of the 101 bush allotments. The greatest reduction of the number of valuable tree species was probably due to the rapid expansion of the banana industry in the mid-1960's. The demand for banana cases led to the uncontrolled milling of the timber resources of Tongatapu, where most of the Kingdom's cases were produced until 1967. As early as 1964, the Annual Report of the Minister of Agriculture stated that:

> The situation in Tongatapu with regard to the felling of trees for the saw-mills is critical as the usual source of supplies [natural forests] have almost depleted [sic] and loggers have already started their attacks on useful trees such as mangoes, candlenut, etc. To make things worse the old feta'anu [Excoecaria] trees on the shore have also been used by millers which consequently will weaken the protection of the coasts and the shores against sea erosion (Government of Tonga, 1965: 21).

In 1968, the Agriculture Department reported that:

> ...the supply of logs on Tongatapu has already reached the critical level following the extermination of natural forests and in some cases useful tree crops also. As a result, most of the sawmillers operating around Tongatapu have moved to 'Eua Island where there is a more abundant supply of logs (Government of Tonga, 1969a: 13).

137 Among the species that were most favored for milling are:
313 tavahi (Rhus taitensis), toi (Alphitonia zizyphoides), tangato (Pleogynium solanderi), telie (Terminalia catappa), feta'u (Calophyllum inophyllum), fao (Ochrosia oppositifolia), mo'ota (Dysoxylon forsteri), ma'ama'alava (Elaeocarpus tonganus), and kotone (Myristica hypargyraea) (Government of Tonga, 1961: 13).

In addition to lumbering, the need for firewood has
[439] also made heavy demands on the tree population. One of the major items sold at Talamahu Market in Nuku'alofa is firewood and on one Saturday the following species were being sold (starting with the most abundant): tongo (Rhizophora spp.), sialemohemohe (Leucaena leucocephala), koka (Bischofia javanica), toi (Alphitonia zizyphoides), loupata (Macaranga harveyana), tavahi (Rhus taitensis), ngatata (Elattostachys falcata), ifi (Inocarpus edulis), tava (Pometia pinnata), mango (Mangifera indica), and orange (Citrus sinesis).

Nature of Fallow Areas

241
125 The survey of 101 sample bush allotments was also concerned with the extent, age and species composition of fallow vegetation. Prior to the survey, selected Tongan farmers were asked about the ages of different fallow areas and within each area the plant species were noted. This showed that a reasonably accurate estimate of the length of the fallow period could be based on species composition

241
134 extension of the cropping cycle reduces the number of stumps, roots, and viable seeds in the ground and slows down the regrowth of valuable plant species and the recycling of nutrients (Nye and Greenland, 1960:32-35). The continued effects of burning also lead to considerable losses of carbonate and phosphate and an almost total loss of useful nitrogen and sulphur (Nye and Greenland, 1960:67).
000 These processes, and a continuing dependence on bush fallow for soil regeneration, will lead to further decline in soil fertility, unless the use of fertilizers and/or other means of soil improvement are sought.

Decrease in Native Tree Species

The combined effects of expansion of plowing, the planting of new coconut palms, the continuing use of fire in clearing, and the need for firewood and timber will probably result in the further elimination of native tree species both from the fallow vegetation and from the few
137 remaining natural forests. Despite occasional protective
313 measures, these tree species continue to be exploited and some are rarely if ever found anymore.

Shift from Traditional to Introduced Vegetation

241 With the gradual elimination of the native primary
178 and secondary forests on Tongatapu and decreasing fallow periods coupled with the government's continued attempts to introduce new plant and tree species, there will probably be an overall shift of emphasis from native and

/50 cont./

291 Instead of the ordinary vala described above, some Tongans
197 (besides the Tongan medical practitioners) wear the vala faka-Fisi borrowed from Fiji (Central Medical School), which has a belt that is stitched on and can be buttoned, as well as two inset pockets. Moreover, European trousers have become somewhat common, especially among the younger generation. This development was furthered by the second World War, that is, by the presence of foreign troops on Tongatapu and the training of a few thousand Tonga in European uniforms. However, the majority of natives still wear the vala, although for certain work (for instance- house-building) trousers are more
[313] appropriate. For lumber work in the bush on Nomuka (on November 21/22, 1951), for example, /51/ of 22 Tongans, 15 wore vala (seven young men, eight older ones) and seven wore long or short pants (six young Tongans, one older one), (127)

127. These 22 Tongans almost all wore the vala to church on Sundays, for the kava gatherings, for festivals, etc.

whereas at a court session (on November 19) on the same island all 21 in the audience appeared in the vala. On a Sunday afternoon (the end of October 1951), in the urbanized seaport and chief city of Nuku'alofa, where generally more /drawing of vala faka-Fisi appears here/ trousers are worn than on the small islands, 22 of the 35 natives observed wore vala and 13 wore long trousers. Here too the Tongans
[292] wearing trousers almost all own a vala for special occasions.

291 The following list may show the specific combination of articles of clothing:

/52/ On November 28, 1951, a sunny day with a sharp breeze, a group of house-builders on Nomuka, along with a kava-group sponsoring this work, wore the following clothes:

/140 cont./

283 and then the three-strand cord is plaited from these small bundles.
283 This method of preparation probably corresponds to the ancient Tongan
178 procedure except for two deviations: In the old days it was probably generally customary to "bake" the coconut husks in an earth oven and only then to place them in the sea; occasionally this complicated method is still used today by leaving the husks (wrapped in koko leaves) (373)

373. Bischofia javanica Bl.

for hours or days (up to one month) in the earth oven--soon grown cold--and thereafter keeping them in sea water for two or three weeks. [171] Secondly, in former times, the natives probably wound the little fiber bundles with a single fiber before plaiting them, as is occasionally still done in Samoa; this procedure is slower, but guarantees greater durability of the cord.--Making coconut cords is men's and [462] women's work, but is done mostly by the men. Often, several men do [574] the plaiting together, and they also like to do this work in the kava [276] gatherings. However, the cords are much less often made than they were even a few decades ago when one constantly saw men plaiting kafa in the kava circles. In those days they apparently also liked to lay in a supply, and the demand for better built houses of ancient Tongan [461] style was probably greater. Today, three men plait up to 200 meters of coconut-fiber cord in four hours (as a day's output). In this way three people can, in three months, make the necessary amount of kafa for a rather large house of ancient Tonga style, whereas they finish this work for a small house in less than a month--if they persist in plaiting their quota every day.

342 A further concern of the Tongan who wants to build a house in
313 the old Tongan style is to procure the posts and beams. The Tonga
[824] Islands are poor in lumber, and if a person does not have a few koka
[439]

/140 cont./

342 313 [824] [439] trees (Bischofia javanica Bl.) or toa trees (Casuarina equisetifolia L.) at his disposal on his plantation (bushland)--as in old times--and does not wish to sacrifice valuable breadfruit trees to make posts, then he must go to an uninhabited island where--again as in old ways--he will look for suitable trees, or else he will buy imported Canadian or New Zealand building timber which, moreover, is preferably used instead of coconut palm trunks for the beams. To build a house in old Tongan style, which is supposed to have board walls and be covered with corrugated sheet metal, and especially to put up a European-style construction, a person must, in good time, buy enough corrugated metal, imported wood, nails and possibly cement in the commercial centers of the Archipelago and transport them to his native island in the small cutters.

342 177 439

342 264 574 /141/ Since a man must generally supply food for the specialist (in case such a one is building the house) and all his helpers (otherwise the orderly course of the work might easily be endangered as a result of growing apathy), he must, in due time, raise quantities of food plants and, in addition, depending on the size of the understaking, fatten a number of pigs. If a man does not wish--or is not able--to offer hospitality in this ancient Tongan style, he must have in readiness sacksful of flour and sugar, large cans of corned beef, tea and, if possible, loaves of bread, in order to provide meals.

342 331 After all preparations have progressed to the point where they can guarantee a steady flow of work, the day is set for the building to begin. The work force assembles on the day announced; the work begins.

[177] [178] The following account of the building of a house in November/December 1951 on Nomuka may show the juxtaposition (or fusion) of old and new:

/141 cont./

342 For a long time the "district officer" /cited in English/
177 living on Nomuka has wanted to move out of the house of his parents-
178 in-law and build his own house on a property he owns in the village.
463 He talks over his plan with Vilingia, the (approximately 45-year-old)
331 house-building specialist on Nomuka, who has been trained in Fiji as a carpenter. They decide to build a house with ancient Tongan ground plan but with "improved beaming," wooden walls with a cement base, windows and doors and a corrugated sheet metal roof. Vilingia draws a construction plan in an exercise book. The district officer
(439) buys four metal drums of cement, Canadian building timber, corrugated sheet metal and nails, flour, fat and sugar in Nuku'alofa and has the supplies brought to Nomuka in cutters. Six men from Nomuka sail to
(484) the uninhabited island of Tonumea, a half-day's journey distant, there
(313) chop down 12 breadfruit trees, cut them up as beams and take them
(283) home. Coconut-fiber cord is also made in sufficient quantities. After all the material has lain ready for several weeks, the district officer decides to start the building. Shortly before the date fixed,
(251) a group of natives sail to the neighboring island of Nomuka Iki, there shoot one of the half-wild cows of the "boss," cut it up properly and, in Nomuka, salt down the meat in wooden tubs, under the supervision of an aged Tongan.

342 On the day the building is to commence, some 20 men from the
476 village (young and old in approximately the same number) assemble early
313 in the morning at the previous dwelling of the "boss," and, after a
331 breakfast of fried cakes /cited in English/ (Tonga: keke) and orange-leaf tea, they repair to the plantations, led by the carpenter Vilingia, where, because of the exalted position of the "boss," they take the liberty of selecting and cutting down the coconut palms needed for the rafters, without asking permission from their respective

331 /141 cont./
342 owners. The palms chopped down with the big axe (toki lahi) (see
476 above) are cut up with the same axe into nine-foot (or eleven-foot)
(313) lengths and, for further preparation, are placed on two smaller
342 (properly notched) logs. The "jacked-up" logs are then provided with
476 longitudinal grooves by two Tongans standing opposite each other
335 who, with the big transverse hatchet (fale-vatu lahi) (see above),
412 strike blow after blow, each /worker/ forming a longitudinal groove;
331 /142/ the two longitudinal grooves meet as they are struck, so that the second of the two workers can, with his blows, simultaneously tear the bark and wood out of the resulting fissure and thus lay it open. After turning the log slightly on its supports, another Tongan, /applying/ blow after blow with the big axe, slits the resulting work-piece (the rafter-to-be) on one side. After a further turning, the two men start cutting another lengthwise groove with the transverse hatchet. The process is repeated successively until 10,12 or 15 rafters (kahoki), depending on the circumference of the trunk, are marked off all around the log. Then the kahoki (which already have a preliminary slit on one side) are separated from the log with the big axe and a pointed club (crowbar). With a machete the rough chips are removed and the rafters are loaded on two-wheel, horse-drawn carts and taken to the building site in the village.

331
342 There are no reports about how rafters were made in ancient Tonga.
335 However, it is to be assumed that today's work which seems so primi-
178 tive to us was carried out in the same way in those days, and that
179 there is a change only with respect to the axes, the iron blades of the transverse hatchets and the measurements with English foot rules.

342 The groups of natives, each working on the felled coconut palms
335 (young and old separately, but also individual older men among the
476 young ones), busily engaged, though soon stopping for rather long
461
331

331 /142 cont./
342 rest periods, make 110 rafters by early afternoon. Then they go back
335 to the building site and around 16 o'clock they each have an earth-
476 oven meal, prepared in the meantime by their wives and other women,
[46] from the supplies of the "boss"; each man is served a portion (yams,
[264] manioc, kape, bananas, pork, beef) in a traditional coconut-leaf
[262] basket and with it a coconut mug containing fish soup. Thereafter the
[415] work in the village is resumed: five Tongans sitting crosslegged
[516] "plane" the rafters by striking them with the small transverse hatchets
(fale-vatu si'i, toki taha-taha, toki tele) or with the machete, two
natives cut more rafters out of trunks which are brought from the
plantations, and 12 Tongans hold a kava gathering at the site to
"sanction" the building project, while three women prepare the
[264] evening meal. This is eaten when twilight sets in (around 18:30):
[262] everyone present gets three or four fried cakes and highly sweetened
orange-leaf tea in coconut bowls. Around 19 o'clock everybody goes
home.

342 On the second building day, while several younger natives split
313 off and plane more rafters and a kava circle of elders is gathered on
335 the building site, six Tongans and the carpenter go to the plantations
331 (after the fried-cake and orange-leaf-tea breakfast) to get sections
of curved beams (for the narrow sides of the new building). According
to an apparently very old system, these are cut out of coconut palm
342 trunks that have grown with a special curvature. Again the men work
335 with the big axe and the big transverse hatchet. From each palm a
331 curved section of beam is obtained. Around 13 o'clock- after they
[264] have cut up the seventh palm, they grow listless, build a fire, roast
a few green bananas in it, have a snack and then go back to the
village, leaving the remaining five palms of the day's quota for the
342 following day. Around 14:30, /143/ 'ota 'i mango (a refreshing drink
272 of grated green mangoes, grated coconut meat, water and sugar) is
264

824 /162 cont./
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[372]
[152]
[524]

(old); serves to deep fire smoldering (old); as fuel (old). "Towel" (old), "toilet paper" (old) and to clean shoes (new): the fibers are also used to press out the grated coconut meat (old); the juice of green, warmed husks and the crumbly material between the fibers of old husks are used to treat wounds (old); used for making children's toys (sailboats) (new?).

[352]
[285]
[372]

5. The palm leaves (lou niu): used, as is, to sit on in the bush (old); used to make floor mats (takatapu) (old), fans (old), baskets (old), hats (for example, helemeti and tata faka-polis) (new); needed to make house walls and roofing (old); used in dry form as fuel (old).

[285]
[287]
[412]

6. The center rib of the leaflets (tu'a niu): used in plaiting baskets (old) and fans (old) and in making tapa stencils (see p. 328); used in making brooms (old).

/163/
[482]
[372]

7. The leaf stems (tome): used as carrying sticks (see p. 250) (old); in dry state as fuel (old); also used to keep fire going (smoldering leaf stem wound with tapa) (old).

[287]
[415]

8. The bast fiber at the base of the leaf stem (kaka 'i niu): used to make tapa stencils (under side) (old) and as a bag for squeezing medicines and food (old).

[313]

9. The wood or the trunk (sino oe niu): used to make rafters and roof laths (old); used as posts and beams in houses (old?), as single posts on the plantations and for palisades (old).

[278]

10. The bark (kili oe niu): used to make medicines (for stomach pains) (old).

[227]
[278]

11. The roots (aka oe niu): used to plait fish baskets (traps, finaki) (old) and to make cuttle fish hooks (tailpiece) (old); the juice of roots serves as medicine for abdominal pains and headaches (old).

it maybe designated as the most useful plant of the /163/ Tonga Islands.

245 Cook reports that he came across coconut palms on Tongatapu "in astonishing numbers." (427)

427. J. Cook, Beschreibung...loc. cit. VI. p. 237.

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likely owing to the combination of a number of factors, both physical and cultural, not the least of which are rainfall, general weed and grass growth and the custom of burning acreage prior to planting.

The key to the maintenance of soil fertility in the islands under the present pattern of cultivation is the system of "bush fallowing" and close planting of crops which results in the retention of some humus in the soil (Great Britain Colonial Office 1956-64, p. 20). This, along with the soil characteristics described, make some minor leaching and nitrogen depletion the major problems regarding the soil's physical properties.

Vegetation is luxuriant and includes most typical tropical types with a number of superimposed imported varieties, particularly food producing plants. In addition to introduced food crops, an undesirable feature of plant life which has been introduced is weeds which pose problems for agriculture as well as being a bother to the human element (Pacific Islands, Vol. III, 1944, p. 37). The most significant of these are the grasses, including Nut, Guinea and Johnson varieties (Jansen 1973).

Forestry potential presents perhaps the most valuable aspect of natural vegetation aside from food production. The total area of all forest lands comprises approximately 26,000 acres which are confined to the islands of 'Eua and Vava'u. This resource is owned and managed by the government. However, it is presently of little commercial value due to the problems of resource inaccessibility and transportation of the milled production. Most activity in this

101: Clark K-4,5 (1974) 1978 OU9 Tonga OU9

313 sector is directed to the construction of banana cases and local
313 housing construction. It should be noted, however, that since
654 1954, the Tongan Department of Agriculture has begun a small scale reforestation program designed to determine the feasibility of developing this as an exportable economic resource (Great Britain Colonial Office 1956-64, p. 22).

241 Other species of vegetation which are culturally important to Tongans are those which produce the majority of the nation's food. These include the breadfruit, coconut, banana and various root crops.

433 Until recently, Tonga has had the distinction of being one of the few Pacific territories which could be called a self-supporting community (Harris 1966, p. 127). Economically, Tonga is essentially an agricultural country. There are no notable developed mineral resources and the only industry consists of minor processing
439 facilities for agricultural products. Economic necessities from outside the islands are paid for by exports of bananas and coconut
457 products in most cases. Until recently, Tonga enjoyed a favorable balance of trade. However, this balance has tended to reverse in the past few years with the tendency toward larger and larger deficits as shown in Table 20.

511 The population in the past has been in the position to plant
[439] a large portion of their food requirements. Any cash requirements were usually provided through the sale of bananas and coconuts to regional collection points (Great Britain Colonial Office 1956-64,
511 p. 11). This subsistence system is rapidly altering due to increasing
178 A [See Category 457, p. 124--Analyst.]